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Increasing Business in Large Motors.

It is interesting to note that the tendency among the leading electric motor companies seems to be towards increasing the size and capacity of their machines.

It was not a very long while ago when a 30 horse-power electric motor was considered very large. Since that time the Sprague Electric Railway and Motor Company, of New York, has put upon the market a 75 horse-power motor.

We illustrate in this issue a new 50 horse-power motor manufactured by the Sprague Company, which has given very good results in practice, and which promises to fill a long existing demand for a motor of this size.

As can be seen by the illustration, the motor is very similar to other machines manufactured by this company.

The efficiency of this machine is quite high, and attention has been paid to the mechanical and electrical construction in order to allow the machine to give a high output.

The motors are automatic in their operation, regulating for a constant speed with varying loads, a necessity in operating most kinds of machinery. The governing device is entirely in the winding of the motor and consequently inert, therefore there are no mechanical governing parts to get out of order.

Self oiling bearings are used, by means of which a thorough and complete lubrication of the armature shaft in the bearings is maintained.

"Puck's Girdle Round the Earth."

Mr. Herbert Laws Webb, of the Metropolitan Telephone and Telegraph Company, recently read a very interesting paper under the above title, before the electrical section of the American Institute. The lecturer stated the possibilities of the subject of submarine telegraphy, and explained that in a single evening, nothing more than a rapid descriptive sketch could be given. The early history of the art is a fascinating study to the electrician, especially when it is considered that it was this branch of telegraphy which gave rise to electrical engineering, and that the solution of the many electrical problems which presented themselves in the early days of the art, greatly increased our knowledge of the laws of electricity.

The lecturer gave an interesting account of the manufacture of a submarine cable, and stated that from the time the cable was started, until it lay on the bottom of the ocean, it underwent a constant series of tests. Even after it was in position, weekly tests were made. Nothing electrical gets so much testing as a submarine cable.

The cable-ship was then described, the "Dacia" being used as an example, though not the largest nor best known vessel engaged in this occupation. Storing the cable in the ship, the start and the staff of the ship, were in turn described. The first thing to be done before laying the cable, is to make a thorough survey of the locality in which it is to be laid. Sir Wm. Thomson's sounding machine is of very great value in this operation. The deepest sounding obtained by the "Dacia," in the Atlantic, was about three and one-half statute miles. The next operation is landing the shore end, which is enclosed in a small iron cable hut, also containing the testing instruments. The first shore end is generally laid a few miles out to sea, and the cable cut and buoyed. The ship then makes for the other terminus of the line, lands the shore end there, and starts paying out towards the buoy at the first end. Constant communication is maintained between the watcher on the shore end and the engineers on board the vessel. When the first shore end with the buoy attached is reached, a splice is made, and the chief electrician proceeds to the cable hut on shore, where a final test is made, the cable generally being found in perfect condition.

Methods of operating cable lines and repairing the same, were discussed in brief. The only reliable existing authority of any magnitude, on cable laying, is in the French language.

Prodigality in Economy.

C. C. HASKINS.

Mr. Haskins' paper, read at the Kansas City Electric Light Convention, is a very complete *resumé* of various analogies between economy in electric lighting and other branches of industry. He recommends the central station man to follow the example of the cautious man of business, when the dull season comes round, and to make a thorough retrospective examination of methods pursued and results obtained; to judge these results from an economic standpoint, and to exercise economy where the effects to be obtained are of the most positive kind. Concerning economy in the matter of oil, Mr. Haskins cites an instance which occurred on an Ohio railroad, the moral of which is apparent. "The newly appointed superintendent of motive power learned that the valve oil in use, a mixture of black oil and tallow, costing 32 cents per gallon, was giving an average run of 100 miles per quart. He found, also, that an average of one valve seat per day was being faced in the shop. He ordered an oil used that costs 50 cents per gallon, which gives an average run of 200 miles per quart, with only five valve seats to face in four months. Fifteen valve seats to face in a year, as compared with 365, and half as much oil to do the work of the cheaper lubricant. In other words, 25 cents against 32.

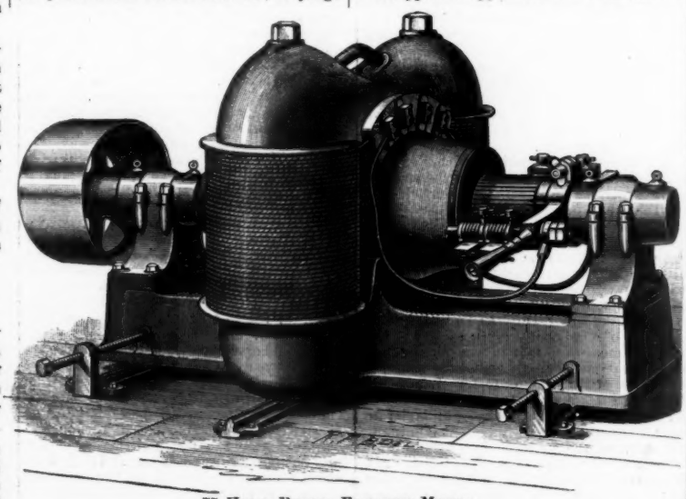
"Another case comes more directly in our line. Oils costing 12 to 15 cents were found to answer well enough in an engine and dynamo room, so far as heating was concerned, but no pains were taken to look beyond that effect, until, after a time, it was discovered that the journals had a silvery white instead of the polished mirror-like appearance they should present. Calipering the shaft showed that with the cheap oil the shaft had worn away more in three months than it should have done with a proper lubricant, in as many years."

Proper and good materials used in line construction at the time of installation, is true economy. One good man to supervise all the others will effect a great saving to his employers in a year's time. Mr. Haskins believes in "one man power," as far as practicable.

"In the experience of almost every central plant management, there is one individual who says that under no circumstances can any electric light wire pass his premises. He seems to have been born a coward, and nothing on the surface of the footstool can make him brave, unless it is one free lamp. The economy here is compulsory, and is not to be questioned."

The magneto-bell is looked upon by the author as "one of the original sins of the business." He has measured a bell which was guaranteed to ring through 15,000 ohms, and found, with a smart grinder, a slight response through 6,500 ohms. The owner of the bell purchased a bridge set the next day.

In conclusion, Mr. Haskins says, that "the prosecution of electrical enterprises is like that of almost any other business, and will be most successful when based on and conducted with true, proven economy, when the most approved appliances and materials are used, and the best ability in each department is employed. An incompetent fireman is a very expensive luxury, a careless lineman is a drain which saps the profit account of its treasure, while a dynamo man or an engineer who watches the clock more closely than he does the gauges or the brushes, is sure to be a heavy brake on the wheels of progress."



75 HORSE-POWER ELECTRIC MOTOR.

Statistics.

It is estimated that at the beginning of the current year about $600,000,000 was invested in the electrical industry, distributed as follows: Telegraph companies, $120,000,000; telephone companies, $80,000,000; electric lighting and power companies, $300,000,000; electrical supply companies, $100,000,000.

The number of telegraphic messages annually transmitted in all parts of the world may be estimated at 300,000,000.

Telegraphers have ways of communicating to each other unknown to common folks. Said one of them, a bright young woman: "If I am sitting next to an associate in an audience-room, I never speak. I simply tap out my message on the hand of my friend." Playwrights might work this into a melodrama.

On the Economical Generation of Steam for Electric Light Stations.

BY GEO. H. BABCOCK, AT THE KANSAS CITY ELECTRIC LIGHT CONVENTION.

In the early days of the introduction of water-tube boilers we were frequently met with the remark: "Oh, they may do very well for woolen mills, but have you any in use in a cotton mill? How do I know they will answer for that purpose?" Or: "Yes, they may be very economical in a sugar refinery, but when you come to driving engines and steam hammers that is another thing; they won't do for that." Of course, the answer to such objections was that steam was steam, and that which made steam most economical for one purpose would do the same for any other purpose—the steam caring nothing whether it was used for refining sugar or driving engines for making flour, cotton or woolen cloth, or rolling iron. But, notwithstanding the plausibility of this argument, it is not quite true, for the work to which steam is to be put, and the circumstances under which it is to be used does in a measure control the conditions under which economy in its generation is to be secured. For instance, the most economical steam generator for railway locomotion would be a wasteful and inefficient apparatus for ocean navigation; steamship boilers and furnaces could not be recommended for factory purposes, nor would the best of stationary boilers answer for a steam fire engine.

There was, therefore, good common sense in the choice of the subject upon which I was requested to address you. The equations which determine the highest economy in generating steam for electric lighting purposes are different from those which would solve the question of economy on a steamship, a locomotive, a fire engine, or even for an iron works, or a cotton mill, though many of the same quantities and much of the notation may be the same.

We need, therefore, first, in considering this subject, to ascertain the peculiar conditions which control the question of economy in electric light plants, and wherein they differ from those of other power stations. These conditions are:

1st. The amount of steam required is not only quite variable, but is subject to unlooked for and sudden changes, which changes are in no way under the control of the management. In places like rolling mills, sugar refineries and dye works, where sudden changes in demand are frequently met, these variations are quite under control, and may be frequently delayed or avoided to favor the boiler house, but in electric lighting they can only be met by either supplying, or failing to supply, the demand. The steam plant must, therefore, be one which will permit of quickly changing the supply to meet the varying requirements.

2d. The maximum demand is for a short period in each day at the best. A curve plotted to show the output of electricity in a station having a good patronage, will show considerable variations day by day, but always a mountain peak at about the same hour. This is peculiar to electric lighting, and has much to do with the question of economy.

3d. An electric light station must be always on hand ready for work. It cannot take a vacation at the pleasure of its proprietor, the whim of its operators, or even the attending of repairs. A breakdown not only stops its own work, but that of many others, and jeopardizes often great and grave interests. Providing a plant, therefore, with apparatus liable to break down or difficult to repair, no matter how cheap in first cost, or economical in the use of fuel, would be, in the homely language of the old adage, "saving at the tap and losing at the bung-hole."

In studying the question of economy in generating steam for electric light plants, it

is quite necessary to take all these conditions into consideration, in order to arrive at a proper conclusion, and to that end we must consider their controlling effect upon certain other elements which are common to all steam plants.

REQUIREMENTS.

For the production of steam we require fuel and furnaces, boilers and brains—the last not the least by any means, when economy is the aim. Let us take these up in order, and inquire what the effect of the environment has upon their selection.

1st. Fuel.—This is a word which covers a multitude of substances, and locality has very much to do in determining the choice as to what fuel is best to use. For instance, in Bogota, rose-wood is found economical; some parts of California, peach stones are used, while in other places sawdust, peat, wood, bagasse from sugar cane, spent tan-bark, straw and numerous other substances, compete with coal on the score of economy. Of coals we also have a great variety, and great differences in price. Anthracite, for instance, varies in price from $16 per ton in some South American localities, to 10c. per ton, the price which the electric light station in Scranton pays for the use of the mountain of fine coal at its back door. Of bituminous coals there are numerous qualities, some of them worth fully double others for steaming purposes, but frequently the local coal of poor quality is cheaper than better coal brought from a distance. It is, therefore, necessary to determine this question for each individual plant, bearing in mind always that the cheapest in price is not always the most economical, and leaving the local circumstances to decide.

2d. Furnace.—The kind of fuel having been decided upon, the furnace needs to be adapted thereto. No one furnace is best for all fuels, and rarely for more than one. For anthracite, a plain furnace with a grate fine enough to suit the size of the coal, and with the greatest possible air space, is excellent, and amply sufficient when intelligently fired. When, however, you attempt to burn bituminous coal in this same furnace, you get poor results and abundance of smoke. The same furnace, moreover, may not be suitable for two different bituminous coals, and it requires great experience to be able to determine just what furnace is best in each case. And just here one of the before referred to controlling conditions of the peculiar environment of an electric light station comes in to modify the selection. It is to the furnace we must look largely for the ability to meet the sudden fluctuations in demand for steam. After the fires have been sluggish for a time on a small demand, it becomes necessary to almost instantly freshen them up to vigorous action. Hand firing and natural draft do not easily meet this requirement, and here arises also the greatest difficulty in the employment of automatic stokers in electric lighting stations; they as a rule do not admit of sudden changes in the activity of the fires. There is much to be said in their favor for all places where the load is comparatively constant, and in electric lighting they will become a source of economy if they can be adapted to the sudden changes in demand, and can be worked with the same economy when firing for largely variant rates of combustion. To meet the controlling conditions, some form of forced draft, regulated by the steam pressure, seem to be essential, so that the moment the pressure begins to fall, the fire may be quickened automatically to meet the requirements. This has been done by attaching a pressure diaphragm to the throttle of the blower engine.

"Smoke consumers," so called, are generally wasteful of fuel, but frequently they are demanded to meet the requirements of local laws. It is well to understand that there is no such thing as "burning smoke," but furnaces can be made to produce a minimum quantity. In this, however, as remarked of furnaces in general, one coal is not any criterion for another. A furnace which will burn a given coal without smoke, will frequently be found to smoke badly when supplied by another coal. This whole question of smoke production is generally more a question of brains in the fireman, than of construction of furnace.

Automatic apparatus for handling coal and ashes is generally a step in the way of economy in electric light stations as in other steam plants. But this is also controlled somewhat by locality, as for instance, when, as in the Edison station in Milan, they pay but 20 cents a day for firemen, the addition of a few extra ones for handling coal and ashes does not add greatly to the running expenses.

3d. The boiler is, perhaps, the one thing which requires the most careful consideration in deciding upon an electric light plant. When we consider that in constant running, a boiler, to speak figuratively, eats its head off every three or four months, it is plain that a reasonable additional cost for an economical boiler is a first-rate business investment. In other words, a boiler which would save 10 per cent. of the coal would pay 30 to 40 per cent. on its cost annually, and would be cheap at a round price as against another as a gift. But how may we know what boiler is most economical, when every boiler maker swears, with or without reason, that his is the one? Usually, in fact, the one with the least foundation makes the loudest claims, even going sometimes to the extent of bombastic challenges and offered bets, on the principle, probably, that that will enable him to rank among the *better* class. Preposterous claims are freely indulged in by the ignorant. I knew a case, some years ago, where a maker of a new boiler offered to guarantee, under heavy forfeiture, that he would evaporate 19¼ pounds of water to one pound of coal! And within two months I have seen a letter stating that a certain boiler, having no single element of economy, would do double the work in the same time, and with the same coal, that another boiler, which is known to give 75 to 80 per cent. of the theoretical efficiency of the fuel, could do!

Unfortunately, buyers are not all scientists, and too frequently the biggest story, however preposterous and unsupported, if unblushingly made, is permitted to weigh more than real merit. But, as I asked above, how are we to judge and decide this question? Here are some general rules:

(*a*) Act down all claims to the evaporation of over 12 pounds water per pound of combustible (unless it be oil, gas or hydrogen), under any conditions, as made ignorantly or with an intention to deceive, and avoid such boilers as are claimed to do this, as either humbugs or soda water factories.

(*b*) See if the boiler has the elements which are necessary to economy, such as a rapid and thorough circulation of water, thin heating surfaces, a well distributed flow of the hot gases, of sufficient duration to secure thorough absorption of the heat, and ample disengaging surface to permit the steam to be drawn off free from entrained water.

In this matter of circulation of water a caution needs to be given, also, as against many unfounded ideas and claims. To secure an effective circulation of water the currents must not only be separated from each other, but they must combine to form a continuous circuit (without interfering eddies or material enlargements), until the steam is ready to be separated from the water. Thus a series of horizontal or slightly inclined tubes, open only at one end, have many interfering currents and but a very slight circulation. Return bends connecting two or more inclined tubes cause such a collision of currents going in opposite directions as to effectually destroy the circulation, and when tubes open into an uptake wide enough to admit a downward curve within it, the most efficient factor of circulation is taken away.

(*c*) Observe the record of the boiler for a term of years. Single tests may be made to show superior results with a boiler which is anything but desirable for actual use. Tests made in regular work are best, if disinterestedly made by competent engineers, but even here one needs to be on guard, as no infrequently tests purposely distorted are put forth as correct. A case in point. Near Manchester, England, a firm having put in a water-tube boiler, employed a well-known engineer of a boiler insurance society to test it. He made out that it was evaporating only about six pounds water per pound of coal, less than the ordinary Lancashire boilers. Suspecting that the test was colored by the well-known antipathy of all boiler insurance companies to any boiler claiming to be safe, on the ground that people may therefore not desire to have it insured, Prof. Kennedy, of London, the best known expert in the kingdom, was employed to make a test of the same boiler, and though it was, as he states, handicapped by the working conditions, he obtained under actual conditions of practice 10 pounds evaporation per pound of coal.

But it is not necessary to enlarge further on this point, it being admitted that in wisely choosing a boiler, the heaviest claims for economy are not necessarily to have the most weight. There is here, as elsewhere in the problem, ample room for a coefficient employed by the late Hamilton E. Towle. At one time he read a paper before the institution of civil engineers in England, and in all his calculations as placed upon the blackboard, there appeared a peculiar and unexplained quantitive character. When he was through, one of the members rose to inquire the meaning of that mathematical sign, which was quite new to them. "That, gentlemen," answered Mr. Towle, "represents the coefficient of common sense, which we find necessary to employ in all such calculations."

But in considering the choice of a boiler for electric lighting purposes, economy of evaporation is not the only necessary element. There are three others of as great importance, if not greater. One of these is the ability to be forced for a short time while the maximum load is on. This is very important, otherwise it is necessary to put in a plant large enough for the maximum, and run it at great disadvantage, except for the two or three hours a day when the demand is at the greatest. But if the boiler, while adapted to the economical generation of the average amount of steam required, can be forced readily to meet the greatest demand, even if it should be at a reduced economy for the time being, the average economy will be better and the interest account will also be less.

Another point of importance is safety from explosions. An electric light plant, as a rule, must be erected in the center of thickly populated communities, and, therefore, it is more important, possibly, to secure safety from explosions in them than in most other steam plants. Now, while a common boiler may not be liable to explode under good care, yet one of the most difficult things to secure under all conditions is this good care. Even the best of men become careless or forgetful at times, and hence good boilers sometimes explode when least expected. It is far better economy, even at a greater cost, to put in a boiler safe from destructive explosions, than to run the risk of a blowing, with loss of time and capital, not to mention human life. Instance the Edison Company at Chester, Pa., where the explosion of a new and well-made return tubular boiler killed seven and wounded eight persons, besides demolishing the building. Even at a much higher first cost a safe boiler would have been good economy. But it is necessary in this matter also to employ a coefficient of common sense, because so many claim safety for their constructions when they violate every element of security from explosion. As a rule, a water-tube boiler properly constructed should be a safety boiler, but the mere presence of water tubes may be no surety whatever. For instance, a boiler with a large shell bored full of holes like perforated cardboard, and strained almost to bursting by reason of water tubes being expanded into these holes—an exceedingly unsafe construction—is advertised as a "safety boiler." Perhaps if the law in this country made the boiler maker criminally responsible for accidents in such cases, as it does in France, there would be fewer such reckless statements. In applying the coefficient of common sense to this problem of safety, one needs to remember that a large shell, exposed to the direct action of the fire, and all flat surfaces, stayed or unstayed, are elements of danger, and that this danger is greatly augmented by insufficient circulation of the water, whereby unequal expansions are permitted to occur, with consequent straining of the metal.

The third important question to consider in selecting a boiler for economy, is its liability to repairs. A boiler which is under frequent repairs is dear at any price, and one in which repairs are not quickly and cheaply made is in the same category. This point is best determined by a long and extensive experience. Nothing else can decide it with any certainty. While tubular boilers may last for years in favorable circumstances, their *average* life is usually stated to be not over 10 or 12 years, and their average repairs are usually estimated at 10 per cent. per annum on their cost. Many go years without repairs, and I do not vouch for this estimate, only giving it as one accepted in ordinary calculations. As for water-tube boilers, the makers of the best known example publish the results of experience with an aggregate of 100,000 horse-power, which had run from two to 20 years, and on which the average repairs to the boiler proper had been but about one-half of one per cent. per annum. They claim, moreover, and it cannot be successfully disputed, that in over 20 years' experience, not a single boiler of that kind has been worn out in use, and that of all which have ever been sold in 23 years, not less than 98 per cent. are in use to-day. It is unfortunate, however, that the same cannot be said of water-tube boilers in general.

Last, but not least, we come to the element of *brains*. No matter how good or cheap the fuel, how perfect the furnace, or how unexceptional the boiler, unless brains are placed in charge the preparation goes for naught. It is not difficult to find a difference of 25 and even more per cent. in economy between the extremes of firemen with the same plant, to say nothing of repairs and stoppages caused by a little carelessness. It pays to have men of brains as well as brawn and muscle, even for firing fuel and watching water.

We have thus hastily considered the necessary conditions of economy in generating steam for electric lighting plants. Let us review them as a whole:

1st. The use of the fuel which gives the best results for the least money. This varies with the locality.

2d. A furnace which will burn the said fuel to the best advantage, and at the same time permit of the rate of combustion to be quickly changed to meet the greatly varying demands without serious loss of economy between the highest and the lowest.

3d. A boiler which will utilize the heat to best advantage; which will give dry steam; which will permit of being forced much above its average rating for short times, without serious loss of economy; which is safe against destructive explosions and which is not liable to frequent difficult or costly repairs.

4th. Foremen and firemen with brains enough to employ all these things to the best advantage, and keep the apparatus at a point of maximum efficiency.

In selecting these elements of an economical plant it is urged that the coefficient of common sense should be fully employed, and that facts gained from long experience are a far safer reliance than mere assertions not backed by years of practical results.

APPENDIX.

The following items, having more or less reference to the subject matter of this paper, will, I think, be found of interest by the members of the Association:

Imperial Continental Gas Association, Vienna.—This plant, which has been at work since August, '87, is very complete and efficient. Its principal work is lighting the Opera House and Hofburg Theatre, which contains the equivalent of nearly 15,000 incandescent lamps of 16 candle-power each. At the station there are eight Babcock & Wilcox water-tube boilers, each having a heating surface of 131 square meters, which are fired entirely with coke and supplied with water from the Danube Canal, which, however, is filtered and chemically purified before being fed into the boilers. Four Worthington pumps are so arranged that the water may be pumped direct into the boilers or first through an exhaust steam heater, all connections being in duplicate. The engines are Willan's direct-acting high-speed, three of 170 indicated horse-power each, and five of about 130 horse-power each, and four smaller ones. These engines run from 400 to 700 revolutions each, according to size. The engines are coupled direct to dynamos of the vertical double magnet type by Messrs. Crompton & Co., the three larger ones giving 250 amperes at 400 volts, and the five smaller ones 130 amperes at 450 volts. The small engines running at 700 revolutions per minute, give 150 amperes each at 50 volts, and are only used for exciting the magnets of the larger machines.

The engine room is fitted with an eight ton overhead traveler to facilitate repairs, etc. In the central station is also a workshop supplied with lathes, winding head and other tools necessary for effecting all repairs, as also a laboratory, photometer room and the necessary offices of the building. In the cellars of each of the buildings lighted are placed large batteries of accumulators having 100 tons of plates in each, which are charged during the day from the central station. At night, and during the performance, the current from both machines and accumulators is used, the latter serving both for storage and regulating purposes.

An elaborate test of this plant was made by Inspector Ehrendorfer and T. W. Melhuish, A.M.I.C.E., a graphic representation of some of the results of which is hereafter given. The following is a summary of economical results obtained, the coke and the chimney gases having been carefully analyzed to determine the available heat in the coke and the amount carried off in the chimney:

The theoretical evaporation with one pound of coke, of water from 32° to steam of 212°, in pounds	11.½	
Of which there were used for generation of steam	79.21	per cent.
There was lost in the chimney gases,	15.47	" "
Waste of coke in ash-pits	.88	" "
By conduction and radiation	4.44	" "
Total	100	" "

77.59 per cent. of the indicated horse-power was delivered in electrical horse-power. The consumption of feed water per electric horse-power per hour was 38.05 lbs. The consumption of coke per electric horse-power per hour 3.78 lbs.

The largest proposed electric lighting plant in the world is that of the London Electric Supply Corporation at Deptford. The buildings now erected are intended to contain when finished 80,000 h. p. of boilers, with the corresponding engines and dynamos. At the present time there are erected 24 Babcock & Wilcox boilers of 250 h. p. each, two compound Corliss engines of 1,500 h. p. each. There are now being erected four engines of similar design of 10,000 h. p. each, that is to say, these engines are double, one-half of which are at first to be erected, to work at 5,000 h. p.; afterwards, a second engine to be coupled to the same shaft, making them full 10,000 h. p. each. Each engine is to drive directly a single dynamo sufficiently large to employ its entire power. The smaller engines, 1,500 h. p. each, are to give off 1,250 electric h. p., after deducting loss in mains, switches, flues, etc., and the 10,000 h. p. engines, with their single dynamo, are to give off 10,000 electric h. p. each. The exhaust from the engines will be connected into one main, with separate condensers worked by independent engines. The dynamos are constructed for the alternating current. The exciters are driven by triple expansion engines running at 280 revolutions. The feed water for the boilers is taken from the hot well and pumped through economizers, of which there is one in connection with each battery of six boilers. Steam pipes are of copper

of six boilers. Steam pipes are of copper throughout, feed pipes partly wrought iron and partly copper. The pressure of steam carried, 200 pounds to the square inch; all exhaust, not only from the main engines, but from the feed pumps and blower engines, is carried into the condensers. The plans for this station contemplate its enlargement at a future day, when it is expected to contain 120,000 h. p. of boilers and engines. It is to be worked on what is known as the Ferranti system, with 10,000 voltage.

The same company have another station at the Grosvenor Gallery, which has been running for some years. It contains four Babcock & Wilcox boilers of 164 horse-power each, carrying 140 pounds pressure, which are worked continuously, night and day, to upwards of 1,000 horse-power. The engine room contains one Corliss engine of Hargreaves' make, 4' diameter of cylinder, running at a piston speed of 780 feet, and coupled by ropes to a Ferranti dynamo, with a capacity of 15,000 eight candle-power lamps. Three other horizontal high pressure engines, with ordinary slide-valve expansion cut-off gear, are connected to a counter-shaft, from which another dynamo of smaller capacity is driven. Another engine and dynamo is kept in reserve for lighting the Grosvenor Gallery or to act as an exciter to either of the above dynamos. The exciters of the large dynamos are attached to an armature shaft, and form really part of the machine itself.

The next most important electric lighting company in London, is the Metropolitan Electric Supply Corporation, Limited, who have at present four stations, of two of which data was given.

Sardinia Street Station.—This contains four Westinghouse engines of 250 horse-power each, driving by belts alternate current dynamos, and two smaller Westinghouse engines of 50 horse-power, driving exciters by means of belts. There are five Babcock & Wilcox boilers, of 250 horse-power each, carrying 150 pounds pressure per square inch.

Rathbone Place Station.—Five boilers of 160 horse-power each, carrying 200 pounds pressure per square inch, and six Willan's triple expansion engines, coupled direct to Elwell-Parker dynamos, giving 1,000 volts and 100 amperes at a speed of 355 revolutions per minute; number of alternations, 12,000 at this speed. Two smaller similar engines are coupled direct to continuous current Elwell-Parker dynamos, giving 150 volts and 180 amperes, used for exciters. All the connections, both steam and water, are made on the multiple arc principle.

The Kensington and Knightsbridge Electric Light Company have two stations, one at High street, Kensington, and the other at Chapel Place, Knightsbridge. In the former are two Babcock & Wilcox boilers, giving 500 horse-power indicated, and two high pressure compound Willan's engines directly coupled to Crompton dynamos. This station is soon to be increased to about 2,000 indicated horse-power.

In the Knightsbridge station, there are two Babcock & Wilcox boilers, giving 700 indicated horse-power, the engines and dynamos being substantially the same, which is also to be increased to about 1,900 indicated horse-power. In the two stations there are, therefore, after making allowances for spares, about 1,900 kilo-watts available, or the equal of 57,000 ten candle-power lamps, lighted simultaneously. As, in the Crompton systems, accumulators are employed as a means of distribution and reserve, these stations will be equal to the supply of 75,000 lamps burning simultaneously, and, according to London practice, 150,000 lamps can be rented out.

The cost of producing a unit has steadily decreased in this station, until it is claimed that the cost for fuel, oil, water, and all wages and material used for working the station and other general repairs, being divided out to the number of units sold to consumers during the month, amounted to only $1\frac{1}{16}d.$ ($2\frac{1}{4}$) per metropolitan unit. Messrs. Crompton & Company would be very much interested to know whether, in America or any other country where the work is being carried out on an equal scale, any economical efficiency approaching this has been obtained.

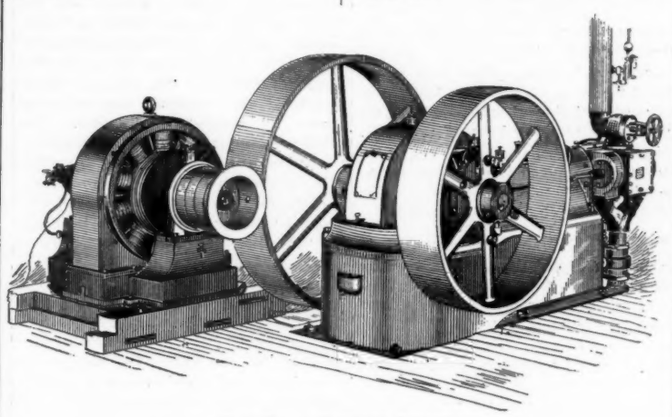
Another Good Point Scored.

Every other illuminant pales before the electric light. That this is so is well instanced by the demands made by parties in the rural districts, who use their own gas machines, to have their gas converted into electricity. With a view to meeting these demands, the National Meter Company, of 252 Broadway, and Mr. O. Tirrill, proprietor of Tirrill's equalizing gas machine, of 39 Dey street, New York, have recently effected a combination which will bring joy to the hearts of our brethren in the country.

The combination consists in a Tirrill equalizing gas machine, a Nash gas engine and a Perret dynamo. The arrangement is automatic from first to last, the light is much steadier than gas, to say nothing of its other advantages, and a long felt want is filled. The dynamo used is the Perret automatic compound machine, the efficiency of which could not be better illustrated than by its many recent combinations with small engines of this kind, where the power supplied is very limited as compared with the results to be attained.

A 25-light plant of this description is now in very successful operation at 39 Dey street, New York.

Scranton, Pa.—The Kirwan Electric Station Indicator Company, of Scranton. Capital, $25,000.



THE EVANS FRICTION SYSTEM.

The Evans Friction System at Franklin, Mass.

This cut shows the Evans system of driving dynamos as applied to the 500-light alternator at the Union Electric Light Company's station, Franklin, Mass. The pulley on the dynamo is 12 inches in diameter, and the face of the engine pulley is 12 inches. The dynamo runs at a speed of 1,500 revolutions per minute.

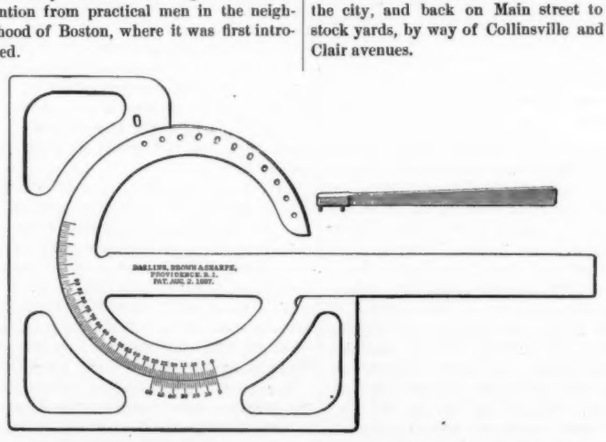
With the full load on this machine the main switch has frequently been opened and closed without any perceptible slip in the friction. With no load, and light loads, the loose part of the belt is farthest from the line of contact. With heavier load, owing to the more powerful *tripping* forces, the slack part of the belt is at that portion which is about to pass between the pulleys.

It frequently occurs that dynamos give trouble from heated bearings, but the application of the Evans system prevents that annoyance. This new method of applying power to dynamos is attracting considerable attention from practical men in the neighborhood of Boston, where it was first introduced.

Pittsburg, Kan.—The Pittsburg Electric Railway Company, of Pittsburg; capital stock, $50,000. Directors, B. F. Hobart, of St. Louis, Mo.; A. E. Stillwell, of Kansas City; Frank Playter, H. B. Wilson and F. E. Doubleday, of Pittsburg.

Albany, N. Y.—The Edison Electric Illuminating Company has filed with the secretary of state the record of its second increase of capital stock. Originally the corporation was capitalized at $1,000,000; Jan. 19, 1886, the capital was increased to $2,500,000, and Jan. 20, 1890, to $4,500,000.

East St. Louis, Ill.—H. D. Sexton and several other capitalists organized the East St. Louis Electric Street Railway Company, and will immediately apply for incorporation. The company will have a capital stock of $500,000, and will apply for a franchise to operate an electric railway through the principal streets. They expect to run from the river, east on Broadway to Main street, down Main street to the southern limits of the city, and back on Main street to the stock yards, by way of Collinsville and St. Clair avenues.



Draughtsman's Protractor.

The protractor illustrated in our cut is one of Darling, Brown & Sharpe's productions. It is made from $\frac{1}{16}$-inch sheet steel, and is light and durable. The length of the blade is $8\frac{1}{2}$ inches; the gradations read to degrees, and the vernier reads to two minutes. This protractor is chiefly used in connection with a T-square or straight edge. It can be quickly and accurately set by hand to any angle. A lever is, however, provided, as of possible advantage in very fine settings. There are no projections on either face of the protractor, and consequently it can be used on either edge of the blade, or either side up. This makes it particularly convenient in dividing circles, transferring angles, drawing oblique lines at right angles to each other, or laying off given angles each side of a vertical or horizontal line, without changing the setting.

Altogether it seems to be a very convenient labor-saving tool for a draughtsman to have among his instruments.

Portland, Me.—The Boston Electric Valve and Motor Company. Its purpose is to carry on the business of manufacturing, selling and dealing in an electric valve and shut-off, water or electric clocks, dynamos or any other electrical or mechanical device. The capital stock is $250,000. The officers are: President, William B. Chase, of Swampscott; treasurer, Henry M. Nichols, of Boston; directors, Laban Heath, of Revere; Hiram Houghton, of Northampton; William B. Chase, Joseph Beals, William C. Bryant, of Greenfield; Henry M. Nichols, Frank W. Eddy, of Westfield; Henry A. Skinner, of Greenfield, and Elijah N. Harding, of Cambridgeport.

Bedford, O.—The Bedford Electric Light and Power Company, of Bedford; capital stock, $15,000.

Susquehanna, Pa.—The Susquehanna Electric Light, Heat and Power Company, of Susquehanna. Capital, $20,000.

Racine, Wis.—The Racine Electric Company; capital, $50,000; incorporators, John Rodgers, F. M. Fish and J. E. Dodge.

New York City.—The Walker Electric Company has been incorporated here; to manufacture electric meters and general electric supplies. Edwin Scott is president.

Chicago, Ill.—The Bear Electric Company, at Chicago; to furnish electric light and power; capital stock, $3,000,000; incorporators, T. Willoughby and N. H. Hanchell.

Chicago, Ill.—The Commercial Illuminating Company, at Chicago, to furnish electric light, power and heat; capital stock, $25,000; incorporators, C. E. Acker, R. L. Gibson, M. B. Austin.

Chicago, Ill.—The Sunbeam Incandescent Light Company, of Chicago; to manufacture and sell incandescent lamps; capital stock, $25,000; incorporators, Jean Elliott, F. W. Parker, D. Johnson.

Millvale, Pa.—The Millvale Electric Light, Heat and Power Company, Millvale, Allegheny County; capital, $1,000. Directors, O. Miller, Frederick Klussman, John H. Shaffer, C. VanBuren, Jr., and M. K. Garrett.

Kearney, Neb.—S. H. Sters, C. L. Cornell, G. T. Monroe, P. H. Carey and G. W. Earnshaw, have incorporated what will be known as the Nebraska District Telegraph Company. A system of police, messenger and fire alarm calls will be included.

Naugatuck, Conn.—The Naugatuck Electric Time Company has been organized with J. B. Fuller as president, L. S. Beardsley, treasurer, and I. C. Trowbridge, secretary. The board of directors are L. S. Beardsley, I. C. Trowbridge, J. B. Fuller, R. B. Morse and James Landon.

Albany, N. Y.—The Automatic Phonograph Exhibition Company, of New York city, was incorporated in the secretary of state's office; capital stock, $1,000,000. The trustees are: Felix Gottschalk, Willard L. Candee, Thomas T. Eckert, Jr., Richard W. Stevenson, Victor E. Burke, John G. Prague and James Molinari.

St. Paul, Minn.—The Sprague Electric Railway and Motor Company has closed a contract with Thomas Lowry, of Minneapolis, for the equipment of the entire street car systems of Minneapolis and St. Paul, embracing 200 miles of track in and between the two cities. This will be a large electric equipment, and involves an expenditure of $2,000,000. All systems of propulsion have been thoroughly investigated.

Annapolis, Me.—Senator Lindsey introduced a bill in the Legislature to incorporate the Hamden and Waverly Electric Light and Power Company, for the purpose of supplying electric light and motive power for Baltimore city and county. The incorporators are John W. Clark, A. Gottschalk, George W. Sadtler, Frank K. Murphy, J. L. Nutwell, J. S. Rosensteel and Charles B. Rogers. The capital stock is $1,000,000.

Chicago, Ill.—The Chicago Suburban Belt Line Passenger Railroad and Extension Street Railway Company, at Chicago; to construct a suburban belt line passenger railroad, to be operated by electric power, cable or dummy; also to build street railways to connect with the belt line from terminal points now operated by street railway companies; capital stock, $2,500,000; incorporators, E. E. Harbert, Frank E. Barker, John A. Taylor, and others.

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NEW YORK, MARCH 1, 1890.

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Mr. Robert Underwood Johnson, of the *Century Magazine*, was present at the meeting of the Electric Club last week, and made an interesting little speech in regard to the international copyright bill now before Congress. Mr. Johnson is secretary of the Copyright League, and thanked the club on behalf of the league for the resolution supporting the bill, which was passed previous to his remarks. The bill has been favorably reported by two committees, and it looks now as if success were assured.

The address of Mr. Grosvenor P. Lowrey on "Patent Law, and What Constitutes an Invention," delivered before the Electric Club last Thursday evening, was a masterly presentation of a subject of vital interest to all electricians and inventors. The speaker's easy, conversational style of delivery added much to the enjoyment of his terse remarks. Mr. Lowrey gave some valuable suggestions and ideas to his audience, who warmly applauded his address at its conclusion. The address will appear in our next issue.

Aluminium (99 per cent. pure) is now quoted at $4 a pound. It is not very long since it was $11. Just what it costs to make has not yet been disclosed, but there is reason to believe that if the price should run down to $1, there would still be a manufacturer's profit.

The entertainment committee of the Electric Club certainly deserve to be congratulated on their wise choice of entertainments presented to the club members thus far. Let the good work go on, and see that no guilty club member escapes these edifying and educating opportunities.

The seat of the soul is said by A. H. Stevens, of Philadelphia, to be in the *corpus callosum*, a spongy little body at the base of the brain. Dr. S. says that this is the "seat of the imperishable mind, and the great reservoir and storehouse of electricity, which is abstracted from the blood in the arteries, and conveyed through the nerves up the spinal cord to the *corpus callosum*." The next thing is for the doctor to prove it.

When the Postmaster-General officially declared to Congress that "post office clerks can soon learn the tick of the telegraph machines," he had probably been reading up some of the accounts of telegraphing in the early days of Cornell, O'Reilly and Shaffner, when the superintendents used to run a wire into town, hunt up some boy who wanted to become an operator, spend a week teaching him how to work a Morse register and then move on to the next town.

Mr. Arthur Lord's paper, read before the Boston Electric Club last week, was a pleasing presentation of a timely topic. The address was entitled "Legislation Relating to the Transmission of Intelligence, Light and Power, by Electricity." Mr. Lord discussed the subject in a way which left no doubt in the minds of his hearers as to his familiarity with the subject, and his ability to handle it. The paper was especially rich in historical facts and data of interest.

In our last issue we commented upon the comparative obscurity to which the practical work of submarine cable engineering has been relegated for many years. Perhaps no other subject connected with electricity has received so little ventilation in the periodical or general literature of electrical engineering as ocean telegraphy. Whatever may be the cause of this, our columns this week afford ample evidence that the inherent interest of the subject is not at fault. Mr. Herbert Webb, in his paper read before the New York Electrical Society, an abstract of which we print in another portion of this issue, gives an extremely interesting and entertaining, and withal instructive sketch of the various operations connected with the laying of a cable.

The petitions to Congress asking that the superintendent of the census be directed to investigate the electric danger question, are beginning to reach Washington. The first one received is signed by the Brush, Edison and United States Lighting Companies, the Philadelphia Board of Underwriters, Mayor Fitler, of Philadelphia, and some others. The petition requests an appropriation of $50,000 to pay the expenses of collecting statistics to show: First—Details pertaining to underground and aerial construction, underground and aerial currents, the character and voltage of all currents and their uses; lamps in use, arc and incandescent, and how wired for residence, commercial and municipal service; motors in use for stationary service and motor cars, income and expenses, etc. Second—To make an inquiry, through sources independent of those interested in the industry, as to the casualties resulting from the use of electric currents, both as to fire and personal injuries. This investigation to be made in all cities of 10,000 population and over. The information to be obtained from underwriters, the records of fire departments, coroners' statistics, health boards or commissioners, etc., and arranged to show a comparison between the number of casualties resulting from the use of electric currents, and the use of other agents employed for similar purposes.

IMPORTANT DECISION IN CINCINNATI.

A question of much importance to electric railway interests has recently been decided by Judge Taft, of the Superior Court, of Cincinnati. The City and Suburban Telegraph Association was organized in 1873 and later became the licensee of the Bell Telephone Company, having now upwards of 3,000 subscribers and five exchanges. Under their charter rights and city ordinances the telephone company have a large number of lines on poles along the streets. The Cincinnati Inclined Plane Railway Company, also operating under a charter and the specific consent of the Board of Public Works, changed to an overhead single trolley electric system and began to operate the same, the feeders of the electric railway paralleling the telephone wires on same streets for considerable distances. The telephone company sued for an injunction to restrain the railway company, or compel them to adopt such measures as would prevent the leakage and induction, which, they asserted, was a nuisance, and rendered many of their lines inoperative for business purposes.

Many minor questions were involved, but Judge Taft laid the weight of his opinion on the main question, whether the defendant had any right to "dump electricity into the earth," to find its way into and disturb the enjoyment of plaintiff's lines, and also to operate the system under such conditions as would permit induction to interfere with such enjoyment by the plaintiff. The case was very elaborately presented and argued. Judge Taft, however, decided that the constitutional rights of the plaintiff were to be upheld, that the defendant's railway, *as installed*, was a nuisance, and a decree was ordered restraining the defendant company from operating with any system which uses the earth as return circuit. In the decree is the following:

"The court further finds that there is a known mode of operating street cars by electro-motive power by means of the double trolley, available to the defendant, the use of which will avoid and prevent the injury to the plaintiff above mentioned. As a matter of law, the court concludes that the defendant is bound to adopt some mode of propelling its cars other than the one which inflicts the said injury upon the plaintiff."

A COURT OF PATENT APPEALS.

The Judiciary Committee of the House of Representatives has reported favorably on the bill to establish a Court of Patent Appeals, with three judges instead of five, and calls attention to the following results which may be expected to flow from the organization of such a court:

(1) It would enable the public and patentees to determine the value and validity of patents without serious and vexatious delays, and thus promote the interests of all concerned.

(2) It will relieve the Supreme Court of much of the burden imposed upon it by this class of litigation.

(3) The practice in the Patent Office would become thoroughly fixed and understood, and, as a consequence, the issue of worthless patents, in which unscrupulous persons deal, to the injury of the public, would be greatly diminished, if not entirely suppressed.

(4) It would tend to simplifying the patent laws, by constriction and settling questions of doubt, which are often used by litigants for the purpose of injustice and oppression.

The committee believes that the Constitution imposes upon Congress the duty of securing to authors and inventors, for a limited time, the exclusive right to their respective writings and inventions, and that this duty is very imperfectly discharged when Congress fails to provide proper means to determine questions rising out of patents, before the life of a patent is frittered away by legal delays. Under the present condition of the business of the courts, it requires, ordinarily, from two to three years to obtain a decision in the Circuit Court of the United States, and, if appealed to the Supreme Court, from three to four years more is consumed, so that, if a patent is valuable, or if it is intricate or radical, it usually requires one-fourth of the period for which it is granted to introduce it and secure its use by the public. Under the proposed law, patent cases will be subject to existing regulations governing appeals to the Supreme Court in causes of admiralty and maritime jurisdiction, which require the Circuit Court to make a finding of facts and law, and confines the review by the Supreme Court to questions of law only. As the law now stands, when cases such as those relating to the Bell telephone or the Brush lamp come before the Supreme Court, the contestants may bring car-loads of machinery and records for the nine judges to examine, and from 15 to 20 per cent. of the time of the court is consumed in endeavoring to get at facts which should be determined in the lower courts. The change will be of great advantage not only to the patent litigants, but to all others having business before the Supreme Court. It is estimated that the expenses of the Patent Court will not exceed $30,000 per annum. The profits of the Patent Office for the year ended June 30, 1888, were over $169,000.

POSTAL TELEGRAPH.

Postmaster-General Wanamaker has prepared and submitted to the House Committee on Post Offices a bill providing for a limited postal telegraph service. It provides that the Postmaster-General may lease for a period of ten years telegraph lines owned by private corporations to reach all free delivery post offices, and that he shall employ postal clerks and carriers to operate the line and deliver telegrams. He is given authority to make regulations, fix rates and to extend the system as he may deem proper. In an elaborate argument before the committee, Mr. Wanamaker expressed the opinion that his department now has all needful room for the proposed telegraph offices in the post offices of the country, that the letter carriers can deliver the telegrams, and that post office clerks can easily learn to operate Morse lines and transact the business, in addition to their present duties. He thinks the government will need to make no outlay except for rent of wires, and that it will make a profit on the business. There are now 460 free delivery post offices in the United States, embracing cities containing a population of 10,000 and over. To commence the telegraph service contemplated by Mr. Wanamaker, would require at least 1,500 good operators. The records of the post office department show that the present force of employés is hardly sufficient to keep up the work, and when the telegraph project is started, it will probably be found necessary to engage experienced operators to work the lines.

NATIONAL FAST TELEGRAPHING TOURNAMENT.

The conditions governing the coming National Telegraphing Tournament are:

1. Number of words to be transmitted—from 250 to 500, according to number of entries.

2. Speed combined with excellence.

The instruments to be used will be furnished by the leading electrical manufacturers who have contributed money for prizes.

CLASSIFICATION.

Class A.—Open for all.

Class B.—Open for all, barring those who have a record of better than 11 minutes on the 500 words used in the last contest.

Ladies' Class.—Free for all.

Old-Timers' Class.—Open for those who were in the service prior to 1865.

Entrance fee, $2; except in the ladies' class.

The transmission by each operator will be recorded with a caligraph in the hands of an expert operator, thereby illustrating the value of the writing machine worked in conjunction with the telegraph.

Under date of February 17, C. W. Summers, manager of the Western Union office at Schriever, La., addresses the manager of the Western Union Telegraph Company, New York, as follows:

"I will challenge the winner of the first prize in the coming contest to be held in your city in April next, to determine the shortest time a given number of words can be telegraphed, in a like contest of 100 words for $500 a side. Same to take place at any given place and time. Please inform committee."

The tournament will be held at Hardman Hall, Fifth avenue and Nineteenth street, on Thursday, April 10th, during the afternoon and evening.

CORRESPONDENCE.

What is Transpiring in Electrical Circles at Boston, Chicago and Albany.

OUR CHICAGO LETTER.

Prof. Barrett, the city electrician, has asked for an appropriation of $550,000, for extending the electric light plant this year. Aldermen Dixon, O'Neil and Tiedemann, of the finance committee, refuse to appropriate any money until Mr. Barrett gives a satisfactory account of the manner in which the $330,000 appropriated last March had been expended. The *Tribune* believes that a certain firm of contractors has been favored to such an extent that they had done as they pleased on the work. Of course, an account of expenditures for city lighting is in order, but the above gentlemen that wish this account would probably find (had they the matter in charge) that $330,000 goes but a little way toward constructing and maintaining electric light stations of the magnitude of Chicago's plants. To-night, for the first time, the 400 city arc lights on the North Side will be in operation. They are located two and three to the block, and the illumination will make a vast difference in the streets of North Chicago.

Personal.—Ernest L. Clark has been appointed western agent of the Walworth Manufacturing Company, of Boston. Mr. Clark's office is now in room No. 331, Rookery Building, where he will be pleased to see his many friends.

S. A. Barton, of Boston, Mass., was a visitor in the city this week. W. H. McKinlock, of the Central Electric Company, is spending a short time in the South.

Edwin Floyd, purchasing agent of the Thomson-Houston Company, left Friday evening for a trip through the East.

H. B. Cobb, of Wilmington, Del., was a visitor at the Club this week.

The Electrical Supply Company have added a number of display tables to their retail department, on which are shown shades of various styles and colors, and the finer sizes of magnet wire.

The Central Electric Company, always anxious to advertise okonite, have placed at the main entrance of their new quarters a very large rubber mat bearing the word "okonite." The mat is so fine that one feels inclined to step over instead of on it.

F. N. Bosson, electrical expert for the Thomson-Houston Company, returned this week from northern Michigan where he installed electric light plants in the following mines: Aurora, Norrie, East Norrie, Ashland, Pabst and Mount Hope.

Shay, Stephens & Company have lately placed a solid glass socket on the market. It is made to fit the Sawyer-Man lamp, and can be operated under water.

The Kansas City Electrical Society will hold a special meeting and the first in their new rooms at Kansas City, Saturday evening, February 23. T. F. Clohesey will deliver an address on the "Storage Battery in Theory and Practice."

A Scheme is on foot in St. Louis which, if carried out, will soon change nearly all the cable and horse car lines in the city to electric roads. The St. Louis Street Railway Company are about to close a contract for equipping their lines with electric motor cars. It is expected that the Sprague system will be used. In any event the contract will be for something like $3,000,000. In the event that the municipal assembly grant the companies the right to change their motive power, the grand total will be upwards of $4,000,000.

Mr. W. B. Pearson, the western agent of the Ball Engine Company, has lately closed the following contracts: Rochford Street Railway Company, one compound condensing engine of 100 horse-power; Louisville Hotel, Louisville, Ky., 75 horse-power engine; Pennsylvania Railroad, Chicago Union Depot, one 75 horse-power engine.

The Sprague Electric Company has closed a contract to equip the street railway between Minneapolis and St. Paul.

The Western Office of the "Review" is in receipt of a very neat paper weight, composed of glass with a white background, over which is a mirror, the white letters showing through and reading "Compliments of Central Electric Company, general western agents, Okonite Company, Chicago, Ill." In the upper left hand corner is the well-known trade mark.

If the Necessary Consent of the property owners on 63d street, from State street to Stickney tract, can be secured, it is the intention of a company to build and equip an electric road.

H. A. Glasier has furnished and opened a suite of offices in the Electric Club building, at 103 Adams street, in the interest of J. A. Grant & Company, of Boston, who are the well-known representatives of the McIntosh & Seymour Engine Company. D. B. D.

Chicago, February 22d.

OUR BOSTON LETTER.

Boston Moves the World in street railway work as well as in fashions of thought. Two million dollars' worth of motors and electric cars are to be sent out to St. Paul and Minneapolis from the manufactory of the Thomson-Houston Company.

Can't Afford It.—The Holyoke Water-Power Company will probably delay the building of the $100,000 electric light station till the matter of causing electric light companies to place their wires underground is definitely settled by the legislature. In case the matter is settled against the companies, the local company will give up all idea of making any improvements, as they cannot go to the expense of burying the wires.

Taunton.—It is reported that the Taunton, Mass., Electric Light Company is preparing to put in a new engine and four dynamos at their headquarters on Weir street.

Beverly.—The Beverly Electric Company is engaged in setting up the new alternating 650 incandescent light dynamo recently received from the T.-H. Company of Lynn. The machine is one of the latest made, and has all the latest improvements. The wires for the incandescent system are in position. Their 35 arc light dynamo is now running to its full capacity, while the generator supplies power to about five motors for manufacturing. In a short time the company will be obliged to build a larger central station, when a commodious brick structure will take the place of the present terra cotta colored wooden building.

Rockville.—The Westinghouse Electric Light Company has presented a proposal to the Board of Aldermen, of Rockville, Conn., to light the streets with their system at the rate of $74.50 a year for 2,000 candle-power lights, on a five years' contract. The local gas company has a Thomson-Houston plant in operation, but the city has made no contract with them yet. The local company will be given the preference if they will light the city at a reasonable rate.

New York Visitors.—Mr. Alex. P. Wright and Mr. T. M. MacCoubray were visitors to the metropolis the early part of last week.

Electrical Legislation.—The Boston Electric Club had as guests at its monthly dinner at the American House, last week, Hon. Arthur Lord, of Plymouth, State Treasurer George A. Marden and Gas Commissioners Coffin and Rowell. At the after-dinner exercises Mr. Lord read an interesting paper on the subject of "Legislation Relating to the Transmission of Intelligence, Light and Power by Electricity."

Fitchburg, Mass.—There is trouble in regard to the electric light, telephone and telegraph companies using the same poles. The aldermen granted the telegraph company permission to use the electric light poles, but have voted to reconsider their action.

The Light Question.—After giving the Suburban Light and Power Company the contract for street lighting, the Boston board of aldermen now refuses to grant locations for their poles, which practically annuls the contract. The Suburban Company have taken the case to the supreme court and the Boston Electric Light Company continue to light the city on a temporary contract.

L. H. Rogers, New England manager Brush Electric Company, has just closed a contract for two complete arc light plants with the Haverhill, Mass., Electric Company. The contract is for 100 arc lamps, dynamos, and all appliances—fifty 2,000 candle-power, and fifty 1,200 candle-power—all to be placed in the new station by the Brush Company, where they have recently installed one of the new 1,000-light Brush alternators.

Mr. R. T. White, of 12 Pearl street, Boston, manufacturer of street railway material, was a New York visitor last week.

The Boston Electric Club has issued a circular describing a series of club dinners and interesting papers to be given between now and May. The house and entertainment committee have selected subjects bearing upon one another, and upon the sentiment evinced by the public and the press at the present time. At the monthly club dinners prominent persons will be invited to address the club on matters of interest. S. L. C.

Boston, February 14, 1890.

In the issue of the New York *Ledger* which will appear March 1, will begin a three installment serial with the title, "An Ocular Delusion." The hero is said to be a pen portrait of a gentleman, who, within a few years, was distinguished in the athletic contests of one of the leading colleges. Collegians and graduates, and every admirer of that literature which holds the mirror up to nature, will be interested in guessing who he is. The author of the story is Frank Howard Howe, the talented young journalist.

OUR ALBANY LETTER.

$84 FOR TELEPHONES IN CITIES OF 100,000—REPORTERS AT ELECTRICAL EXECUTIONS—HIGH TENSION SAFEGUARDS, ETC.

Albany, Feb. 18.—When Assemblyman Hill's bill, amending the penal code by putting in the offenses of injuring or interfering with the poles, wires, motors, etc., of electric railways, came up for passage in the Assembly to-day, Mr. O'Hare, of New York, made a short speech about it. He said that in Albany was to be seen the spectacle of an electric road, operated by a system which was a constant menace to life and property—namely, the single trolley system. The wires were uninsulated, and, sooner or later, would cause some such dreadful accident as had already happened in other cities. In Cincinnati, the courts had directed such a road to change its system. The bill passed the house.

Telephone Charges.—Assemblyman Clarke introduced a bill to regulate the charges for the use of telephones in cities of the State having a population of 100,000 inhabitants or over. It fixes the rate at not to exceed $84 a year. A violation of the provisions of the act is made a misdemeanor, and the violator is made liable in a civil action for damages. The violator is also liable in the sum of not less than $50, nor more than $500, for each offense, recoverable at the suit of the people through the attorney-general, one-half the amount to be paid to the State, and the rest to the county where the offense occurred. Special and exclusive lines are excepted.

February 19.—The Assembly committee on electricity, gas and water, reported favorably Senator Hunter's Senate electric railway bill.

Assemblyman J. H. Stevens introduced a bill authorizing water companies to manufacture and use electricity for the lighting of streets, public places and private buildings, in cities, towns and villages.

February 20.—Senator Hunter introduced a bill allowing village water works to furnish electricity.

The Assembly code committee reported Assemblyman Stein's bill allowing newspaper reporters to be present at electrical executions.

High Tension Currents. — Assemblyman Whipple introduced a bill to prevent accidents in the use of high tension electric currents. It makes it mandatory for every person, company, association or municipality, which employs high tension electric currents, the force of which is greater than 250 volts, to use and maintain such safeguards in each and every circuit, as will protect life and property against injury by the breaking or discontinuing of wires.

Telegraph Rates. — Assemblyman Duffy also introduced a bill fixing telegraph rates for the people of the State: For day messages of ten words, exclusive of date, address and signature, ten cents, and one cent for each additional word; for night messages, ten cents for twenty words, and half a cent for each additional word.

Assemblyman Towne had a bill allowing the tax-payers of Jamestown to vote a second time on the question of binding the city for an electric light plant.

This morning Assemblyman Towne wanted to have his Jamestown electric light plant bill advanced at once to a second reading. Assemblymen Sheehan and Blumenthal objected, however, that several diverse interests were involved in the matter, which should be considered in committee. According to committee the bill went. H. P.

Albany, N. Y., Feb. 20th.

Additional Corporations Recently Formed.

Pueblo, Col. — The Bessemer Gas and Electric Light Company, with a capital stock of $100,000, divided into shares of $100 each. The term of existence is 20 years. The directors for the first year are J. S. Stewart, J. A. Dempey, Rees Jones and H. J. Tritch.

Salem, Mass.—The Essex Electric Street Railroad Company has organized as follows: Directors, Frank W. Stanley, T. Howard Fallon, Frank E. Farnham, of Peabody; King Upton, Joseph N. Peterson, William D. Dennis, Patrick T. McCusker, of Salem; clerk, William F. M. Collins, of Salem.

Portland, Me.—The Martin Electric Signal Company was organized at the office of Coombs & Neal, for the purpose of manufacturing and dealing in fire and burglar alarm apparatus, with the following officers: President, Robert D. Weston-Smith; treasurer, Edwin Sheafe; directors, Robert D. Weston-Smith, Edwin Sheafe, W. Orison Underwood. Capital stock, $500,000; paid in, $75.

New Jersey.—The Walker Electric Meter Company has been organized under the laws of the State of New Jersey, with a capital of $200,000, for the manufacture and sale of electric meters and supplies. The president of the company is Edwin Scott; vice-president and general manager, Geo. W. Walker; secretary and treasurer, Louis Tewksbury. The principal offices of the company are at No. 50 Broadway, New York.

GENERAL ELECTRICAL NOTES.

The telephone system in Cincinnati is said to be equal to any in the country. Its efficiency is due to the able management of Captain George N. Stone, who is at the head of the company.

The Bell Telephone Company, of Oil City, Pa., during the present year, will extend their lines through Clarion and Jefferson counties. Central stations will be located in the cities of Clarion and Brookville.

An order was passed in Portland, Me., granting the Commercial Union Telegraph Company permission to erect a line of poles and string wires. The line is in the outskirts of the city and does not run through the principal streets.

The New York Postal Telegraph Company, at its annual meeting in New York, elected the following directors for the ensuing year: Albert B. Chandler, George S. Coe, Edward C. Platt, Hector de Castro, George G. Ward, Wm. H. Baker and John O. Stevens.

In the United States Circuit Court, at Baltimore, before Judges Bond and Morris, on a motion for a new trial, the verdict of $35,000 in the case of the Interstate Telegraph Company against the Baltimore and Ohio Telegraph Company, of Baltimore county, was ordered reduced to $25,000. Otherwise a motion for a new trial will be granted.

At Torrington, Ct., the suit of the Southern New England Telephone Company against the Torrington Electric Light Company has been withdrawn, an amicable settlement having been made. The electric light company recently signed a telephone contract, made all its circuits metallic and parallel, and the plaintiff withdrew the suit and paid the costs.

At the annual meeting of the Central New York Telephone and Telegraph Company, held in Utica, N. Y., Martin A. Knapp and A. S. Belden, of Syracuse, N. Y., Robert S. Williams, Lewis H. Lawrence, Charles A. Nicholson and F. G. Wood, of Utica, and David A. Parker, of Randolph, were chosen trustees. R. S. Williams was elected president, Lewis H. Lawrence, vice-president, F. G. Wood, secretary and treasurer, and C. A. Nicholson, general manager.

It is claimed that a new syndicate is being formed in New York, in which prominent Philadelphians are interested. It is to control both the phonograph and the graphophone in all the world outside of the United States and Canada. Among the capitalists who are interested in the scheme are D. O. Mills, Henry G. Marquand, H. H. Cooke, W. Martin Grinnell, Jesse Seligman and J. M. Waterbury, of New York; also Thomas Cochran, William Wood, George H. McFadden, Thomas B. Wanamaker and Thomas Dolan, of this city. Full plans for the project have not yet been consummated.

Mr. W. M. Donaldson, a very enterprising electrical engineer of Baltimore, has recently entered into the business of distributing electrical energy by means of storage batteries in connection with small motors, for household and office use in the cities of Baltimore and Washington. In Baltimore his batteries are charged by the arc light wires, and in Washington by a Perret dynamo. Mr. Donaldson's business seems to prosper, judging by his recent order on the Elektron Manufacturing Company, for 40 Perret motors for graphophone work. After a series of practical tests, he has adopted the Perret motor for his work. In some recent tests with this motor on graphophone work, using two volt battery, when recording the motor took 2.3 amperes, and when reproducing, two amperes. With the ordinary 100 ampere hour storage cell, the motor will drive the graphophone from 45 to 50 hours, continuously, which lasts an ordinary business man about one month, the battery being then replaced by a freshly charged one, and the discharged battery taken to the charging station.

Telephonic News

Earnings of the Missouri and Kansas Telephone Company.

President Mulvane, of the above company, sends to the stockholders the following, under date of January 1st, 1890:

"We have the pleasure of reporting your property in the best physical condition it has ever been in. Our system of retrenchment and repair, as followed during 1889, has put us in an excellent condition, both for giving good service and handling our property at minimum expense. We have added to our toll lines during the year 248 miles, the bulk of which was only completed in the last months of the year. We show an increase earning of $1,447.33. We have added the exchange at Hutchinson, 106 subscribers; Warrensburg, 38 subscribers.

"Your board of directors for the last quarter declared a dividend of 1½ per cent., making a total for the year of 4½ per cent."

Treasurer Ferguson, of the same company, gives the following statement of the earnings and expenses of the Missouri and Kansas Telephone Company, for the year ending December 31, 1889:

Gross exchange earnings	$367,799 31
Toll line	36,226 96
Miscellaneous	16,703 55
Grand total	$420,729 82
Gross expense	$343,011 10
Net earnings	77,718 62
Increase of gross earnings	26,116 25
Increase of net earnings	106 06
Percentage of expense earnings	81 50
Dividends of the year were paid:	
No. 17 ¾ per cent.	
No. 18 1 "	
No. 19 1¼ "	
No. 20, for the last quarter 1½ "	
Making a total of	54,625 10
Surplus used in reconstruction	23,093 62
Total	$77,718 72
Subscribers added for the year	1,576
Subscribers discontinued	1,348
Net gain	228
Total number December 31, 1889	6,616

Report of the New York Board of Electrical Control.

The third report of the Board of Electrical Control, of this city, has been submitted to the Governor and Legislature, containing the record of the work accomplished by the board during the past year.

The following table shows the construction of subways to date:

Service.	Miles Trench.	Miles Duct.
Telephone and telegraph	28	503
Electric light	29	454
Edison	16	50
Subsidiaries	..	10
Total	73	1,017

This construction will accommodate approximately 45,000 miles of telephone and telegraph wires, and 2,000 miles of electric light wires.

The following table shows the poles and wires which have been removed as the result of work of the board, either by the companies or by the Bureau of Incumbrances of the Department of Public Works:

	No. of poles.	Miles wire.
By companies	1,765	2,788
By Department of Public Works	3,007	2,827
Total	4,772	5,615

SUBWAYS AND UNDERGROUND CONDUCTORS.

The following table shows the number of miles of electrical conductors now in the subways, and the companies by which they are owned or operated:

Name of Company.	Number of miles of underground wire.
Metropolitan Telephone	10,906
Western Union	587
Postal Telegraph	35
United States Illuminating	88
Brush Electric Light	38
Manhattan Electric Light	67
Harlem Electric Light	10
Mt. Morris	2
Edison	252
New York Fire Department	332
Total	12,308

In addition to this underground wire, some 2,000 miles of telegraph wire are being operated in cables on the elevated railroads, under permits of the board.

A Reply to Mr. Ries.

TO THE EDITOR OF ELECTRICAL REVIEW:

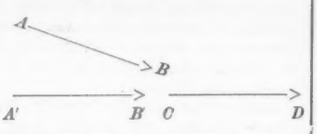
DEAR SIR: I see that Mr. Elias E. Ries takes exception to some of the statements I made, at request of counsel for plaintiff, in the recent case of the City and Suburban Telegraph Company *vs.* The Mt. Auburn Inclined Plane Street Railway Company, tried before Judge Wm. H. Taft, at Cincinnati, and, with your permission, I would like to say a few words in reply.

The first point with which he takes issue is my statement that the defense, to say the least, failed to prove any advantage in traction due to the passage of the current from the wheel to the rail.

You will recollect that one of the claims of the defense was that extra tractive ability was gained by the act of passing the current of electricity in this manner, from which advantage they would be deprived in case the court denied them the right to use the rail as a return for their current. This is a myth that has been floating around in the papers for a long time, like Japhet in search of a father, but with less success than Japhet, for Japhet did find his father eventually, but this story is still an orphan. Mr. Ries seems to have taken pity on the waif, however, and having apprenticed him in his own shop by getting a patent on him, is doing as well by him as if he was his own child. Who more naturally then, than Mr. Ries, should be called by the defense to prove this point? So Mr. Ries appears before the court with two devices, with one of which it was impossible to fulfill the conditions under discussion, and with the other they could have been exactly fulfilled, but *were* not. With these two devices he attempted to prove his point, but I claim not only failed to do so, but really injured the party for whom he appeared, by proving conclusively that whatever the merits of the question at issue, there were other means entirely independent of a ground return, by which increased traction could be attained, thus upsetting the claims of the defense that by depriving them of the ground return it was depriving them of a material advantage to be attained in no other way.

There is no theoretical ground upon which to base such a claim as this. It is true that every electrical current generates a magnetic field at right angles to its length, and if the number of currents be multiplied, or, what is the same thing, if a current-carrying conductor be coiled so as to become many times parallel to itself, this magnetism may become more apparent; and if it be caused thus to pass many times *around* a piece of soft iron, it will impress upon it very strong magnetic properties; but passing a current *through* a piece of iron does not endow it with greater magnetic properties than it does copper or other so-called non-magnetic metals. This magnetism is so exceedingly slight that unless the conductors be coiled many times to increase the effect, it can scarcely be detected, except with very delicate instruments, even where very strong currents are employed. Even this very slight magnetic effect would probably not be produced between longitudinally contiguous particles of a conductor, where it would have to occur to help Mr. Ries, for in the case in question, the two points which are supposed to maintain greater adhesion by reason of the current passing between them, are consecutive points in the direction of the current.

It is the *possibility* that there *might* be some infinitesimal attraction under these circumstances that has caused all, or nearly all, of the experts in this case to hesitate in declaring that there would be *no* attraction; they were, however, pretty unanimous, with the exception of Mr. Ries, in the statement that there could be no *material* advantage due to magnetism. I think I may go still further and assert that there can be *no* attraction at all between the wheel and the rail caused by the passing current, for the following reasons: We know that not only parallel currents but also currents that cross each other either attract or repel each other; that if two currents flow towards the vertex of the angle which they make, or both flow from the vertex, they will attract each other. If, however, one of them flows *towards* and the other *from* the vertex of the angle, they will repel each other.



Thus if we have the two currents *AB* and *CD* flowing in the direction indicated, we would have repulsion. If this be true for the angle given above, it must be true for all angles, and will be true when *AB* makes an angle of 180° with *CD*, or, in other words, coincides with it in direction. We have, therefore, a right to assume that contiguous particles in the direction of the length of a conductor *repel* each other. So we get no comfort here for Mr. Ries.

Again, practically, we have some direct testimony against Mr. Ries' adopted theory, for it is merely a theory.

Mr. Thomas Edison discovered what he termed the electro-motograph principle, which is that the friction *between two surfaces* is *actually appreciably lessened* by passing an electric current from one to the other. Upon this principle he constructed his chemical telephone and many other devices dependent upon a lessening of friction between contacts by the passage of electric currents, and it was even proposed to apply the principle to the journals of machinery for the same purpose, but while it was found that the friction was appreciably varied *inversely* as the current when the pressure between the surfaces was slight, the variation practically disappeared entirely when this pressure became greater. This electro-motograph phenomenon is supposed to be due to electrolysis of the liquid conductor film purposely placed between the two surfaces, and is greatest when the negative electrode is an occluder of hydrogen, such as platinum, or better still, palladium. Iron also has this property, and it is not at all improbable that if Mr. Ries will use a less current to avoid the heating effects, and keep the contacts between the iron bar and the rotating wheels wet, he will find a less traction *with* the current than without it, if the bar be very light, but that this effect will gradually disappear as the pressure increases. In actual practice with street cars, therefore, I would expect the friction to be less in wet or damp weather by cause of passing the current as suggested, though the difference would be appreciable. Then, again, it was in evidence that it is customary to use sand on the tracks in ascending grades. The beneficial effect of passing the current as described, cannot therefore be very marked if it becomes necessary to use sand, and, as I stated, if there were anything in the claim at all, the use of sand would be absolutely bad practice. If there is any extra adhesion, which I deny, and it is due to magnetism, which it certainly isn't, or to any "peculiar molecular condition of the wheel and rail," as Mr. Ries suggested to me as possible, the very addition of sand would defeat the display of the property, because magnetic effects disappear very rapidly with distance—the attractions are inversely as the *square* of the distance—hence, any separation due to sand would greatly diminish the magnetic effect and totally obliterate any effect due to "peculiar molecular conditions."

But there was some effect produced by the passing of the current. Mr. Ries says the pull was one ounce before and two ounces while passing a current of 15 amperes—making, as he claims, an "increase in traction of just 100 per cent." Now, the bar must have been exceedingly light to give a sliding friction of but one ounce, but had it been still lighter and the initial friction been but a quarter of an ounce, it is not improbable that the gain in traction due to the current might have been 700 or 800 per cent. I do not say that it would be, but think the gain would have been very much greater. The percentage loss in friction in the electro-motograph when a current is passing is quite large and appreciable when the pressure between the two surfaces is very slight, but while it probably continues with greater pressures it becomes before long so insignificant with regard to the friction due to the pressure that it is entirely lost sight of. This was one reason why it was desired to experiment with the other device presented, because it was much heavier and it was thought that the difference in traction would entirely disappear.

The device illustrated a case of *sliding* friction and not one of rolling friction as it obtains in street car traction. No electrician would think of building an electric railroad on what is known as a "skidding grade," viz., one so steep that the car would slide down it if the wheels were locked, yet this is what Mr. Ries illustrated in his first model; in this case the contact between the wheels and the bar was always at the same point of the bar, in the case of the skidding grade it would be at the same points on the wheels. In actual practice the points of contact between rails and wheels would never be the same for two consecutive moments.

Mr. Ries states that the current was subsequently measured and "found to vary somewhat on account of the rapid polarization of the battery—the mean strength indicated by the ampere meter being about 16 amperes." As I recollect it the current that first passed through the device was a little over 30 amperes, falling almost immediately to 18. Mr. Ries attributes this to polarization, but such an explanation is totally inadequate—the drop was next to instantaneous, and no battery could polarize to such an extent in so short a time—it could only be accounted for by an increased resistance due to very rapid rise of temperature of the points of contact between the bar and the wheels.

It has been estimated that the area of contact between the driving wheels of a full-sized locomotive and the rail is about ¼ of a square inch. If this be so, how exceedingly small and poor must have been the electrical contact between Mr. Ries' bar and wheels?

With this imperfect contact and the point remaining the same on the bar, the heat generated by the passage of 30 amperes of current must have been momentarily intense, and if it were not for conduction, amply sufficient for welding. The increased heat would increase the resistance largely, which would in turn reduce the current until the heat produced and that carried away by conduction just balanced, which seemed to be at about 16 to 18 amperes. It was observable that it took an appreciable time to fall from 30 to 18 amperes. This was due to the time necessary to heat the point of contact up. The two points on the bar remaining the same, it did not take long for them to get heated; but had these points been constantly changing, as would be the case in rolling friction, they could become but slightly heated—no incipient fusion, oxidation or other physical change would have time to occur—the strength of the current would decline very gradually owing to polarization, and with the small model on exhibition the tractive effort would in all probability have been no greater when the current was passed through dry contacts, and in all probability would have been less if they had been wet.

The second reason why it was very desirable to try the second model, was because there the current could have been passed from the wheels to the rail and by means of the adjustable road bed the experiment of mounting grades both with and without the passage of the current could actually have been performed.

I notice he states that the model was not constructed so as to permit of the passage of the current as desired, and for this reason he objected to its being used. *I will say that any person who could twist a piece of wire to a piece of iron tight enough to make an electrical connection, could have fixed his model so as to illustrate the experiment perfectly, and the change could have been made in one minute or less without damage to the instrument.* He says we wanted to use this model to prove something that "had been satisfactorily illustrated by the apparatus first exhibited." The test already made was *not satisfactory* to any electrician present, and it was because it was *not satisfactory* and could not be made satisfactory with the first model, that the use

of the second model was sought. He further states that "in addition to the apparatus already described, there was placed in evidence the result of practical tests made with the same device upon a much larger scale, and though these results have a most important bearing upon the point under consideration, they have apparently been entirely overlooked in the argument referred to." My recollection of the tests referred to is that they were made by converting the wheels of the locomotive into magnets by means of coils on their axles, and not by passing the current from the wheels to the rails. I am not sure about this point, but if I am right, the experiments referred to had no reference whatever to the question at issue, and if I am wrong—if the added tractive effect was due to the passage of the current from the wheels to the track—it was still a method equally applicable to the double trolley or storage battery system; nevertheless, a mere recital of what has been accomplished, without an exact statement of the conditions under which it was accomplised, falls far short of proof of the fact, and does not stand a moment in the face of the fact that quite as wide variations of time in ascending grade is not only possible but common, even under conditions where no electricity or magnetism or other aids are used. I know that one engineer can pull a train over a grade that another would almost fail in surmounting.

He says the current employed was that given by four cells joined in series with probably an electro-motive force of six volts and an intensity of about 16 amperes. The cells were bichromate of potash cells, which, when in good condition, usually give over two volts apiece, so eight volts would probably be nearer to the truth than six volts, and the current, as I have stated, varied from say 30 to 18 amperes, making 240 to 144 watts as the energy, or from a little less than one-third to a little less than one-fifth of a horse-power required to produce an increased traction of one ounce. Mr. Rice calls in question my statement that the current used in this experiment *exceeds in quantity* that usually employed to operate a heavily loaded street car, and then, on the false assumption that I said 96 watts was in excess of that usually employed, etc., offers the gratuitous information that if I will furnish four cells that will operate such a car, I need devote no more time to the discussion of the relative merits of single and double trolleys.

Three or four amperes is all that is necessary to move a car on a level if the usual pressure of 500 volts is used, and the grade must be a very steep one and the car a very heavy one to require 30 amperes. I reiterate that if 16 amperes of current are caused to pass through the motors of any of our heavily loaded street cars they will go along at quite a lively pace and up quite a grade, too, but 16 amperes cannot be forced through such motors by six or eight volts of pressure, and if forced through, the watts will not be 96, but, if the Sprague motors are used, more nearly 8,000.

In regard to his second model of which I said it was operated to illustrate another feature that had no relevancy to the case whatever, he says it was brought "for the purpose of illustrating some of the practical advantages incident to the employment of artificial tractive adhesion."

No one doubts for a moment that increased adhesion, if not obtained at too great expense, is a great desideratum—there was no earthly use in demonstrating that it was admitted, and there was no question about it; the question was *does passing the current through the rails* give increased traction, and the second experiment had no pertinence because it did not involve passing the current through the rails.

He demonstrated that by making magnets of the wheels, he could cause the car to ascend a grade upon which the wheels would skid when the vivifying current was broken, and he showed that when the car was skidding it could be brought to a stop on grade by closing the current and re-energizing the magnets. He might have gone still further if he had arranged the experiment properly, and shown that he could turn the whole thing upside down without the car leaving the rails, "thus completely demonstrating," as he says, "the practical value of increased traction." In fact, however, he demonstrated nothing further than the well-known fact that an electro-magnet will attract iron. He did not demonstrate that his method was practical, because to be practical it must not cost more than it is worth. A magnetized wheel not only offers a greater resistance to sliding, but also to rolling. I know Mr. Ries does not admit this, but any one can demonstrate the truth of my assertion by placing two round bars—one heavily magnetized and the other unmagnetized—upon plates of soft iron and gradually inclining them to the horizontal; the one that has the least rolling friction will roll off first. It will be found that the one having the magnet can be tipped to a much steeper angle than the other. It is a question that does not concern me at present whether or not the increased power required first to produce this magnetism, and second to overcome the increased rolling friction due to it, costs more than the advantages are worth. If he did prove the practicability of this method, he proved exactly what the plaintiffs wanted to prove, viz., that the peculiar advantage claimed for the single trolley system by reason of its ground return could be enjoyed even to a greater extent by abandoning the earth as a part of the circuit.

I owe you an apology for the length of this communication—it is much longer than Mr. Ries' criticism would warrant, but the belief in increased traction by the means suggested is so general in the minds of those who have not given the subject much attention, and it has so little foundation in fact, that I must crave your indulgence.

Very respectfully,
NELSON W. PERRY, E. M.
238 Auburn avenue, Cinn.
February 8th, 1890.

How Our Paths May Be Made Paths of Peace.

BY W. H. POPE, BEFORE THE KANSAS CITY CONVENTION.

Previous to the introduction of the telephone, the standard of out-door or pole line construction may be said to have been that established by the Western Union Telegraph Company, or organizations that from time to time came under its control by purchase or consolidation. The lines of these companies were never of a superior character, nor in any way comparable at the time with those erected in European countries, and it was not until after thorough inspection and exhaustive tests were made by a prominent English electrician, employed for the purpose, that extensive alterations and improvements were made, greatly increasing the efficiency of the wires, and, naturally, their more economical operation.

The construction of a most excellent line along the route of the Pennsylvania Railroad, between Jersey City and Philadelphia, by the management of the American Union Telegraph Company, previous to the absorption of that company, marked a new era in line construction, but, notwithstanding the brain that inaugurated this departure afterward controlled the great competing company, the standard thus established was never closely followed by them.

However parsimonious the Western Union Company may have been in their construction and maintenance expenditures, telephone, electric light and similar corporations would have been greatly enriched by literally following in their footsteps. They encouraged and provided for increased conductivity and tensile strength and fair insulation, and established a department of competent and reputable electricians and experts, to insure a systematic compliance with specifications and requirements, destroying the evil that had grown into prominence, which permitted officials to exploit hobbies of their own to the detriment of the business and the ridicule of electricians. To those of us who have been identified with electrical interests for the last quarter of a century, there seems to have been no notable improvement in the construction, except as shown in the recent interstate lines of the American Telephone and Telegraph Company. The introduction of the telephone brought into the electrical field a very large class of workers devoid of electrical knowledge or experience. To this class, the methods employed and the standard of construction prevalent, were superior to the necessity and requirements of the telephone. This opinion and the lack of sufficient capital to properly exploit the telephone business was primarily the cause of the introduction of poor material and workmanship, as well as the small wire and insulators, together with porcelain knobs and cheap insulation.

With the experience of our predecessors in the electrical field, and with the knowledge of the character of the current we were handling, it would seem as if a superior character of construction and insulation would have been deemed imperative; yet, with the exception, perhaps, of conductivity, everything in connection with the conducting of the current was inferior to that previously used by corporations using harmless voltage. That such was the case is due somewhat to causes similar to the introduction of the telephone—but the use of cheap insulation, what is popularly and properly known as "undertakers'" wire—was due wholly to the ignorance and stupidity of underwriters' officials, to whom many of us protested repeatedly against its use.

The accumulation of poles, the inferior character of the materials used, and the utter disregard of public consideration or the character and beauty of the surroundings, gradually moulded public opinion against poles and wires in general, and electric lighting in particular.

The desire of electrical manufacturers to crush their competitors, was accelerated by distressing accidents, until every publication throughout the land magnified the dangers of electricity, depreciated our property, and retarded the progress of electric lighting and electric propulsion beyond our comprehension. To this condition of things we must now devote our attention—adverse legislation is cropping out in nearly every State of the Union, tending to regulate voltage—to bury the wires, and to accomplish other reforms too numerous to mention. In view of all this, it should be the aim of electric lighting corporations to so reform the existing methods of construction as to show a decent regard for public opinion as to safety and the appearance of their structures in the public thoroughfares. By a sincere effort in this respect, beneficial improvements can be introduced without necessitating large expenditures, and the clamor for the removal of overhead wires reduced to a minimum. Where there happens to be an unnecessary aggregation of poles, endeavor to perfect an arrangement whereby poles may be occupied in unison, and as many poles removed as circumstances will admit. Such a course will reduce your maintenance expenses, and create for you favorable public opinion. In the erection of poles, considerable attention should be devoted to their design and proportions, and the character of finish, to the end that the structure may be made pleasing to the eye. The removal of a pole because of deterioration, or with a view to the erection of another with greater capacity, should be followed by the substitution of one in every respect superior in strength, design and finish. The question of expense, as compared with common poles, should not be allowed to deter you from the ultimate purpose of replacing your entire line, especially in cities or towns where the burial of wires would be a financial impossibility.

To those familiar with the recent excellent structures of the Long Distance Telephone Company, or those of some of the electric railways, the possibility of improving upon the present methods of construction will readily suggest itself. While it is not advisable to use iron poles, combination of wood and iron can be used to advantage in many instances. The practice of introducing wires into the front of buildings is an objectionable method and should be discouraged when possible. This can often be obviated, as well as hundreds of other similar disreputable and unsightly practices, if given a little personal attention and consideration by the general manager.

It will be frequently discovered upon investigation, that lines of poles erected in the streets in front of buildings can be removed to an alley or street in the rear, or constructed over private rights of way by the payment of a nominal consideration. Where such a condition of things is possible, it will be found desirable and preferable to incur the expense and make the change voluntarily.

Reduce, rather than augment, the number of poles which at the best cannot be else than unsightly. Provide every pole with iron steps and paint the poles as thoroughly as you would a house, and select colors that will not make your poles more conspicuous than they really are.

In so far as a neat, well designed and substantial brick station, reduces your rate of insurance, gives character and substantiability to your investment, so will the improvements suggested—however small and insignificant at first—if properly and sincerely carried out, win for you favorable consideration and fair treatment, and enhance materially the value of your property, besides tending to postpone indefinitely the removal of overhead wires.

It should be the aim and policy of all electrical corporations to constantly improve the condition of poles and lines—giving as much attention to their strength and beauty as to their perfection electrically. The assumption that such a course is unwise, because of the theory that sooner or later all wires must be buried, is wrong, because it is questionable whether such an extreme will be reached, especially in cities and towns of small population.

Every day that you delay these improvements you encourage adverse criticism and hasten adverse legislation, State and municipal.

Subways and underground structures are not pleasant things for the strongest of us to contemplate, and where, heretofore, you have had only the gas interest to advocate these measures, you now have competitors in the electric light business, urging legislation against overhead wires with the same earnestness as inventors and manufacturers of cables and subway appliances. These interests are better equipped with facts and figures than has been the case heretofore.

A policy such as outlined, and a vigorous State organization of electric lighting companies, will protect our interests from any severe measures at the hands of the general public.

TELEGRAPHIC

.... Advices from Shanghai report that the junction of the Chinese telegraphs with those of France in Tonquin, and with the Russian lines at Kiachtha, is expected in a few months.

.... Work is being pushed rapidly on the east and west extension of the Newark and Granville, N. J., electric road. A connection will soon be made between the west end and the Baltimore and Ohio depot.

.... The annual meeting of the Commercial Union Telegraph Company, of Maine, was held in Portland, last week. The following directors were chosen; Col. H. S. Osgood, Portland; Henry Russell, Albany, N. Y.; F. N. Dow, Portland; Albion Little, Portland; E. J. Slattery, Albany; S. R. Small, Portland; I. W. Wakefield, Bath; C. E. Arnold, Albany; G. C. Wing, Auburn; W. D. Pennell, Lewiston. The board organized with Col. H. S. Osgood as president, Hon. Albion Little, treasurer, and S. I. Larrabee, clerk.

OUR ATLANTA LETTER.

Mr. H. J. Crowley, recently from the Thomson-Houston works in Lynn, Mass., has assumed charge of the railway department of Thomson-Houston's Southern office in Atlanta.

Machinery for Thomson-Houston plant has arrived at Griffin, Ga.

Tuscaloosa, Ala., has started 650 alternating incandescent and 50 arc lights, Thomson-Houston system.

South Pittsburg, Tenn., has started with 300 lights alternating incandescent, and 30 arc lights; city lighting, Thomson-Houston system.

Macon, Ga., has recently added 100 arc Thomson-Houston lights to their plant, which is giving increased satisfaction.

Nashville, Tenn.—An extensive plant for general power, street railway and lighting, is being erected in that city, under the Thomson-Houston system.

Chattanooga, Tenn., has just received two 50 arc light machines for their rapidly increasing system of lighting, Thomson-Houston system.

Franklin, Tenn.—Wires and poles are up and machines are placed and the plant will be in operation in a few days for 300 lights alternating incandescent, 30 lights arc, Thomson-Houston system.

Athens, Ga.—The Athens Gas and Electric Light Company has started with 50 arc lights and are pushing the alternating system for incandescent, Thomson-Houston.

Mr. W. T. Gentry, manager of the telephone business in Atlanta for the Southern Bell Telephone Company, has started for St. Louis. From that point he will make an extended business trip throughout the West.

Mr. H. C. Patterson, of the engineering department of the Thomson-Houston Company, of Boston, is in this city, and inspecting the general work of the Southern department of the Thomson-Houston Company.

Macon, Ga.—The Macon City and Suburban Street Railway have abandoned the old steam dummy line, and substituted eight cars run with the Thomson-Houston system.

The Thomson-Houston Company, of Atlanta, have just leased a new building and fitted it up with offices to meet the fast growing demand for office room.

The Electricians Meet.—At a meeting February 5th, at Atlanta, Ga., steps were taken to form a club. Twenty of the 48 electricians who propose to form themselves into an electric club met last night at the Zouaves' Armory for the purpose of taking steps toward organizing. In order to get the club into working order Mr. J. M. Stevens, manager of the Western Union Telegraph Company, was elected chairman, and Mr. F. E. Clarkson, superintendent of the Georgia Phonograph Company, was unanimously requested to act as secretary. A general discussion as to the purposes of the club ensued, in which all the gentlemen present took part. It was generally agreed that the objects of the association should be mutual, social, benefit, and also to educate and advance the members in the great and growing science of electricity. Messrs. F. E. Clarkson, W. T. Gentry, G. H. Wade, W. S. Hight, H. H. Jackson and A. V. Curran, were appointed a committee to draft a constitution and by-laws, and also to select suitable club rooms. The committee will meet to-morrow at 3 o'clock at the offices of the Georgia Phonograph Company to perform the duties imposed upon them. When the constitution is completed a meeting will be held and officers elected. F. E. C.

Atlanta, Ga., Feb. 6, 1890.

* * Augusta, Ga., is to have a new electric road between the city and the suburbs.

* * Butte, Montana, wants an electric railway between that city and Anaconda.

* * There are no more prosperous or progressive cities in the United States than St. Paul and Minneapolis, and it will be interesting to know that they have both officially ordered the substitution of overhead electric railways in all their streets where horse cars have been used heretofore.

* * Burlington, Ia., is to have an electric street railway. An ordinance granting an exclusive franchise to operate such a road for 30 years has passed a first and second reading at a special meeting of the city council, and only needs the signature of the mayor to become authoritative. It provides that the cars must be running by the 1st of November.

* * The Shreveport, La., Railway and Improvement Company have contracted with the Thomson-Houston Electric Company, Chicago, for the equipment of their road, the Belt Line. The equipment will consist of an 80 horse-power automatic generator for four cars, for immediate delivery, and eight to follow, each supplied with 20 horse-power motors. The contract price aggregates $30,000.

* * F. W. Horn, of the railway department of the Thomson-Houston Electric Light Company, of Chicago, has been awarded the contract for the entire equipment of the Shreveport Railway and Land Improvement Company's belt line of street railway, consisting of an eight horse-power automatic generator, four motor cars, each equipped with single 20 horse-power motors, with the necessary overhead construction, the road to be in operation within 60 days.

* * It is claimed that a device intended to prevent the endangering of human life by the breakage of electric light and street railway wires, has been invented by Stephen D. Smith, an employé of the Postal Telegraph Company, at Milwaukee, Wis. If a wire breaks and the ends fall to the ground, this apparatus, which is placed in the power house, near the dynamo, instantly grounds the current, and stops the flow of electricity over the broken wire, which might otherwise be a source of great danger.

* * The Fort Wayne, Ind., Electric Club met last week and elected the following officers: President, Charles C. Miller; vice-president, Harry McKinley; secretary, Eugene McLachlan; treasurer, Louis Freyer. Messrs. Judge Taylor, McGaw, Jackson, Woodruff and Hough, were appointed a board of managers. David Freyer, Henry Wellman and Arthur Hadley, comprise the committee of membership. Addresses were made by General Manager McDonald, Judge R. S. Taylor, Perry A. Randall and others.

* * The Hercules Mining Company, of Pittsburgh, have just concluded a contract with the Westinghouse Electric Company, of this city, for a large number of Tesla motors to be used to drive their electric drills in coal mines. The Monongahela Gas Company have just put the motors in their mines and are much pleased at the new digger. The company first tried compressed air to drive their drills, but this did not give satisfaction. With the electric drill they are enabled to do the work of two or three men. The production of coal is 600 square feet floor space in 10 hours. This can be done by one man operating the drill, and the estimated cost of mining is less than one cent per bushel.

* * Actuated by the example of Minneapolis, where the street railway company has thrown aside $400,000 worth of new cable apparatus before laying a foot of it, and is now equipping 110 miles of track with electric motors, Cincinnati is seriously considering the question of adopting electricity on all the city lines. It is generally believed that this will not only add to the profits of the local street railway company, but will act as a material impulse to the growth of the suburbs. It is a significant fact that in almost every case where electric railways have been laid in cities, one of the first results of the innovation has been the erection by city people of residences in the adjacent country.

* * During the last week, Mr. Thos. Lowry, president of one of the largest street railway combinations in the world, showed his confidence in the electric system of street railway propulsion by deciding to equip all the lines of St. Paul and Minneapolis by electricity. The electric company to whom this contract was awarded is the Sprague Electric Railway and Motor Company, and the investment called for from the street railway company is said to be in the neighborhood of $2,000,000. By the terms of the contract the Sprague Company is to fully equip and put into working order the entire mileage owned by the railway company, the work to be completed by June 1st, and the first delivery of electric railway apparatus, which will include 400 improved motors for the equipment of the rolling stock, will be made shortly.

* * An interesting and novel application of electric power has recently been made in New York City by the local agent of the Sprague Electric Railway and Motor Company. In one of the theatres a spectacular play is being presented, in which one of the features consists of a horse race on the stage. In order to keep the horses constantly in view of the audience, the platform upon which the horses race is endless, and kept constantly moving over a pair of rollers at each end of the stage. When the question of motive power for this movable stage was suggested, a Sprague electric stationary motor was selected for the work. This is belted to a system of counter-shafting, which reduces the speed to that required by the rollers over which the movable platform revolves. This is rather a novel application of electric power, but it is simply an example of the extensive and varied use to which electric motors are now being applied.

* * When electric railways were first introduced, it used to be commonly said among street railway men that the motors were not built sufficiently durable and strong for the necessities of street car service. Such charges might have been true at that time, but they are certainly not applicable at the present day. The durability of the electric street railway motor, as exemplified by the productions of the leading supply companies of to-day, is probably as high, if not higher, than that of any other machine exposed to the same kind of service. We are in receipt of some quite interesting statistics from Erie, Pa., in regard to the operation of electric cars on the line of the Erie Electric Motor Company, in that city, which illustrates this in a striking manner. One motor car on this line has run 19,300 miles without requiring any repairs of any kind. A second car, equipped with only a single motor, has run 15,000 miles without repairs being required, and other cars have records very nearly as large. When the arduous work required of these street railway motors is taken into consideration, this is truly a remarkable record, and one which is most gratifying to all interested in electric traction. The Erie Electric Railway has been in operation for a number of months on the Sprague electric system, and is said to be giving great satisfaction to the managers of the road, and to the general public. The equipment of the road is complete in every respect. At the station the power plant includes two 150 horse-power Ball engines with 16"x16" cylinders, each engine being belted directly to two 50,000 Watt railway dynamos, which furnish the current to the line. The motor car equipment consists of 15 electric cars, equipped with the Sprague improved motors and all the latest attachments and devices used.

OUR LONDON LETTER.

ITEMS OF ELECTRICAL NEWS AND PROGRESS FROM THE BRITISH EMPIRE.

In continuation of my notice of the work carried out by the leading firms during the past twelve months, I have now been favored with particulars from Messrs. Woodhouse & Rawson, United, Limited, and others. Since the various businesses of Messrs. Woodhouse & Rawson, Limited, the Woodhouse & Rawson Supply Company, and the Woodhouse & Rawson Manufacturing Company, together with others at Manchester and Bradford, there has been a steady and most satisfactory progress in the amount of manufacturing business done. Several patents have been brought out or acquired, among which the new insulating substance which can be used for all purposes in place of slate, gives early promise of great success. In the supply department there has been remarkable increase in the amount of work done, and by a transfer of show-rooms to 30 Cannon street, buyers have been greatly facilitated in their task of inspection of electrical goods. As regards the contract department, Messrs. Woodhouse & Rawson have shared in the general success of the year. Among the contracts may be mentioned, the houses of Lord Brassey, Sir F. Carden, Scrase Dickens, Esq., etc., and Messrs. J. J. Murphy's brewery and Messrs. Findlater's, and also the palace of the Maharajah of Mysore. For the supply of instruments, contracts have been made with the London and North Western Railway, the Caledonian Railway, the Manchester, Sheffield & Lincolnshire Railway, the National Telephone Company, as well as several governments, including the Admiralty. At the Bradford portion of the business, installation work has been heavy and, as contractors to the corporation, the electric light has been installed in a large number of buildings. One of the greatest successes of Messrs. Woodhouse & Rawson has been their identification with the Elmore depositing process, for which an English company was lately formed, and the shares are now at three times their nominal value. An interim dividend has been declared by Messrs. Woodhouse & Rawson, Limited, of 15 per cent., and if the company continue their progress and exercise the same care as hitherto in the inventions they take up, the shareholders may look forward to reaping rich harvests, and electricity will have deep cause for gratitude for the most substantial assistance in its journey towards the utmost limit of success.

Messrs. Davey, Paxman & Company, owing to increased business, are still further extending their works, which were largely increased some 18 months ago. The excellence of the company's engines, which were selected for a large portion of the driving at the Paris Exhibition, and which have gained great honors during the last few years, notably at the Newcastle and Society of Arts trials, are no doubt principally responsible for the extension in the works and for the large increase in the business which has necessitated it.

Messrs. C. A. Parsons & Company, of Heaton Works, New-Castle-on-Tyne, have now their new works situated close to the Heaton station of the North Eastern Railway in full operation. The firm are busy with the manufacture of slow speed dynamos of several types, together with other specialties, and have on hand a large order for the Italian goverument for large projectors and automatic lamps for coast defence, of improved design, as well as large contracts for material for the Newcastle and District Electric Lighting Company. The special design of their new works is to meet the great demand for high-class electrical machinery.

Messrs. Felten and Guilleaume, of Mulheim on the Rhine, who are represented in this country by Messrs. W. F. Dennis & Company, 11 Billiter street, London, E. C., have been extremely busy in the manufacture of iron, steel and bronze telegraph and telephone wire, and of cables for telegraph, telephone and electric lighting purposes. It is owing to the use of this company's underground telegraph cables that the German telegraphic system has proved so safe in the severest storms. A line has now been opened from Carlsruhe to Stuttgart, 50 miles in length, and formed of seven-core cable, the cores being insulated with gutta percha. Last year was also opened the Buenos Ayres-Montevideo Telegraph and Telephone Line, which is in many respects remarkable. There is a submarine section of 28 miles in length, on each side of which are aerial bronze lines of 70 and 97 miles, respectively. The line is constructed on the metallic circuit system, and is used simultaneously for telegraphy and telephony, and works most admirably in regard to clearness, and fullness of sound. The company's electric light cables, which are principally of the impregnated fibre lead-covered type, are worked with great satisfaction in the central lighting stations at Hamburg, Bremen and Lübeck. The plant for the manufacture of bronze telegraph and telephone wire has been greatly increased during the year, and with the bronze wire, several interurban telephone lines have been constructed in Germany, Austria, Sweden and other countries.

At the Chapel Royal, Savoy, the electric light is being installed, and the chapel will be closed until the second Sunday in February.

The United Engineering Company, Limited, of 3 Prince's Mansions, 68 Victoria street, Westminster, have amalgamated with Messrs. Statter & Company, of West Drayton, and the future title will be the Electrical Engineering Corporation, Limited.

The Series Electric Traction Syndicate have entered into a contract to work the North Western and Midland District Auxiliary Railway Company's line, which is over seven miles long, by electricity. A further 15 miles of tram-road are at present under contract for construction, and a contract has also been concluded with the Rome Tramways' Society to experiment upon the line on the Via Flammia outside the Porta del Popolo.

The Edinburgh Exhibition Buildings are rapidly progressing. There are two principal buildings, one to contain the electrical and engineering exhibits, with a central span of 80 feet, and two lateral galleries of 20 feet and 15 feet, respectively, on each side, and about 800 feet long; the other building is for the general industrial section, and covers a space of about 250,000 square feet. The arc lighting has been given to the Brush Electrical Engineering Company, and the principal portion of the incandescent system has been taken up by Messrs. King, Brown & Company. The committee of the exhibition are advertising for tenders for working the electric railway in the grounds, and which is to be not merely an exhibit, but to be used for many practical purposes, including the providing the visitors with a means of getting from one portion of the exhibition to another. It has been suggested that it would greatly add to the popularity of the exhibition if a commemorative exhibit were added to celebrate the penny post jubilee, which occurs this year. *Apropos*, the Forth Bridge was tested last week, a train weighing 2,000 tons, and composed of 100 loaded coal wagons, being slowly run over it.

At Bordeaux, the preparations for the electric lighting are advancing rapidly. There are to be four towers 90 feet high, each supporting a 4,000 candle-power arc lamp. The lamps are to be grouped, two in series, at the pressure of 110 volts. The current is to be supplied by Gramme dynamos, giving 180 amperes and 110 volts at 1,000 revolutions per minute.

For the London Electric Supply Corporation, Limited, the laying down of the Ferranti mains from Deptford is now to be begun, and in about two months we may expect to see the work, which so many causes have delayed and hindered, accomplished.

It is reported that every one wishing to subscribe to the Joule International Memorial Fund, should send their subscriptions to the Hon. Secretary, International Joule Memorial Committee, Royal Society, W.

The first weekly meeting, for the present year, of the Royal Institution, Albemarle street, W., which took place last week, was devoted to an address by Professor Demar, F. R. S., on "The Scientific Work of Joule." Sir Frederick Abel was in the chair.

One of the Quickest installations ever carried out has just been accomplished by Messrs. B. Verity & Sons, of Covent Garden, who were lately asked to light up the offices of *Tit Bits*, in Covent Garden, and when they inquired in what time the work was required to be completed were informed "by to-morrow." The task was undertaken, and in about 20 hours the editor of *Tit Bits* was working with the comfort of electric light. The installation has been successful in every particular.

The Electric Line of Mr. Magnus Volk, at Brighton, suffered greatly from the terrible gales last week. The sea washed away the shingle upon which the track is laid, and over a hundred yards of the line along the Madeira road has been demolished. It was greatly feared that the terminal station opposite the aquarium would be carried away by the heavy waves.

The Paris Municipal Council, which has the granting of licenses for public electric light installation is now placing a clause in all its agreements that the machinery and plant made use of must be made by French firms. As a fact French goods are employed by all companies with the exception of the Popp Company, who usually employ American and English, and fortunately for that company its plant was established before the council's decree was promulgated. A most favorable report having been made by Professor F. W. Kohlrausch, the town council of Hanover have decided to adopt the electric light. Seventy-five thousand pounds has been voted for the installation of 15,000 lamps, and the contract has been given to Messrs. Schuckert and Company who will use the three-wire system in conjunction with accumulators. CHARLES FFRENCH.

London, February 4, 1890.

"Patent Law, and What Constitutes an Invention."

A COMPREHENSIVE AND INSTRUCTIVE ADDRESS ON THE ABOVE SUBJECT, BY MR. GROSVENOR P. LOWREY, AT THE ELECTRIC CLUB.

There was a large number interested in patent work in attendance at the last meeting of the Electric Club, February 20th. The announcement that Mr. Grosvenor P. Lowrey, the prominent patent attorney, would deliver an address on "Patent Law, and What Constitutes an Invention," was the means of bringing together not only a number of the electrical people of the city, but a number of patent attorneys and inventors in other lines. In the absence of President Madden, in Europe, Mr. H. L. Storke presided most gracefully.

The lecture was highly entertaining as well as instructive, and contained a vein of humor, in addition to a great deal of sound sense, that caused numerous interruptions from applause.

The REVIEW will publish the lecture in full in its next issue, with the discussion which followed.

The question of copyright law was brought up as being closely identified with patent law, and Mr. Robert Underwood Johnson, of the *Century Magazine* Company, who was present, spoke at some length in favor of the copyright bill now before Congress.

The Club unanimously adopted the following resolution, upon motion of Mr. Geo. M. Phelps:

"*Resolved*, That the Electric Club, of New York, is in hearty sympathy with the present efforts of American authors, publishers employing printers and workmen in the printing trades, to obtain from Congress a just recognition of the rights of intellectual property, and we hail with satisfaction the prospects of an early passage of the International Copyright Bill."

Among the gentlemen present were, John Van Horne, vice-president Western Union Telegraph Company; C. L. Buckingham, Gen. C. H. Barney, Dr. George H. Benjamin, E. E. Bartlett, J. C. Chamberlain, E. A. Colby, J. J. Carty, Chas. Dutton, Jarvis B. Edson, D. L. Gibbens, E. M Hamilton, Jos. B. de Lery, T. J. McTighe, J. P. McQuaide, F. Z. Maguire, W. J. Morrison, Geo. M. Phelps, C. W. Price, W. S. Perry, John C. Reilly, R. M. Bailey, John A. Seely, A. F. Stanley, W. D. Sargent, H. L. Storke, J. H. Seymour, T. C. Martin, C. D. Smith, Robt. J. Steen, E. J. L. Van Houghton, Geo. C. Wilde, Geo Worthington, Jos. Wetzler.

A delightful lunch was given after the lecture, with the compliments of the entertainment committee, and a quartette of singers from the New York University rendered a number of pleasant songs.

The evening is to be added to the long list of successful meetings of the Electric Club.

Cabs With Electric Dials.

A problem that has puzzled inventors over here has just been solved in Paris. Seven cabs have this week been furnished with seven different and rival methods of ascertaining the lengths of ten different fares. The systems will be on probation for a month and at the end of that time one will be selected for universal adoption. They vary very little in design; what has to be ascertained being which system will work with greatest accuracy and at the lowest cost. As you enter the vehicle a dial faces you which registers your liabilities. The very act of entering sets free an electric current and the dial announces that you already owe half a franc for taking the cab. Then when you start on your journey the dial shows every kilometer you go, with a charge of 25 cents for each. The rotations of the wheel supply the means of ascertaining the distance, which is, of course, the same whether the speed is great or little. At any moment the hirer can tell exactly how many miles he has gone and his exact fare, and the cabman, who is thus paid by mileage with a fixed entrance, finds his own interest in driving fast and getting as many jobs as possible.

—— The Electric Railway Company at Asheville, N. C., has been handling freight. An ordinance has been passed forbidding it in future to deliver freight save to warehouses. The company has always handled express matter under contract.

San Francisco Claims the First Electric Light Station.

TO THE EDITOR OF ELECTRICAL REVIEW:

In your issue of January 4th, a correspondent seeks information regarding the first electric light plant installed in this country. The question is certainly one of general interest. If he means a "central station" for the distribution of lighting circuits from a common center, the first plant of the kind in the United States (reputed also to have been the first in the world) was erected is San Francisco, Cal., in 1878, by the California Electric Light Company (Brush system), under the management of Geo. H. Roe. The concern began operations with two or three small arc light machines, and a year or two later illuminated the entire neighborhood, without any dynamos, by taking fire and burning to the ground. The works were re-erected and several times enlarged, owing to increase of business, until at present the Brush Company does the lion's share of electric lighting on this coast, both arc and incandescent. It has only recently completed one of the finest and largest central electric lighting stations in the world. Respectfully yours,

AMANDUS.

San Francisco, Jan. 31, 1890.

Electric Lighting at the Metropolitan Museum.

The arrangement of the electric lights that the executive committee of the Metropolitan Museum of Art has determined to place throughout the entire building, has caused the committeemen a great deal of bother and worry. Several different methods of arranging the lights are required in galleries devoted to different sorts of exhibits, and there were different opinions as to the best arrangement of lights for the galleries of paintings. Some of the committee favored clusters of lights in the center of the ceiling, and others preferred lines of lights over the rows of paintings. There were still other methods proposed. The question was settled by having the electricians arrange lights according to different methods in different rooms, and then letting the full committee take their choice. The system adopted was to suspend rows of electric lights from the ceiling around the sides of the room, about five feet from the walls. Metal screens were placed close to them, reflecting the light downward upon the paintings, and throwing the interior of the room into the shade. Now that this is settled upon, the work of lighting every gallery in the museum is being rapidly pushed, and very soon the museum will be thrown open on Tuesday and Friday nights.

Gas.

The other day three people were killed by gas in Oakland. Cal.; a few days later another man was killed from the same cause, and probably next week two or three more deaths will be reported from some part of the coast.

If one of these four people had been killed by electricity, the daily papers would have been howling yet about the terrible dangers of using it.

Tested by the actual loss of life, the use of electricity is nothing like as dangerous as that of many of our modern appliances for saving labor and adding to the comfort of the people.

Gas kills 20 men every year where electricity kills one; blowing up of steam boilers destroys still more; the victims of railroad accidents are found everywhere.—*San Francisco Electrician.*

—— An electrician has just patented something as new as it is unique in the way of a clock. Aside from being a regular timepiece and calendar, it is also provided with a system of keys making a double circuit around the outside of the clock, the first one to denote the hour and the minute, and the other the day of the month. The object is to furnish thereby a regulator for business appointments. For instance, if a man had an appointment at 9.10 o'clock one morning, he would turn the indicator to that time. At the minute exactly that morning an alarm would be turned in, and would continue to ring until stopped.

—— The Queen City Electric Light Company of Dallas, Tex., will erect a new two story brick building 200x200.

—— A semi-annual dividend of three per cent., payable on demand, has been declared by the Hartford Electric Light Company.

—— The Westinghouse Electric Company have purchased 160 acres just east of Brinton station, Pa., for the erection of an electric plant to cost $200,000.

—— An electric plant (vegetable plant) is said to have been discovered in India which has the power of affecting the magnetic needle at a distance of 20 feet when the weather is favorable. In rainy weather it has no electric influence whatever.

—— Kentucky has hitherto been considered a very poor field for the progress of electric lighting. A few days ago, however, the Westinghouse Electric Company was awarded the contract for a 3,000-light plant, of the alternating current system, in Lexington.

—— The first central station electric light plant on the alternating current system for Japan, is about to be established. A corporation of Japanese capitalists in Tokio has awarded the contract for the apparatus to the Westinghouse Electric Company, of Pittsburgh, Pa., and the machinery, consisting of two 750-light dynamos, as well as exciters, lamps, sockets, switches, cut-outs, etc., will be shipped immediately. The company which purchases this apparatus is also engaged in the installation of a lighting plant for the city of Canton, China.

—— The annual meeting of the Lowell Electric Light Company was held at the company's office, on Middle street, last week. Of 1,500 stockholders, 1,291 were represented. The following officers were elected: Clerk and treasurer, John H. McAlvin; directors, George W. Fifield, W. A. Ingham, George L. Huntoon, Willis P. Burbank, Charles R. Kimball, John H. McAlvin. The stockholders voted to increase the capital stock from $150,000 to $300,000. This was the first meeting of the company in Lowell since the re-organization under the laws of Massachusetts.

—— The Illuminating, Heat and Power Company, of Scranton, Pa., held their annual meeting last week and elected the following officers for the ensuing year: President, B. H. Throop; vice-president, James P. Dickson; treasurer, G. A. Fuller; secretary, F. C. Hand. The board of directors elected is composed of B. H Throop, James P. Dickson, G. A. Fuller, C. O. Wisner and Franklin Howell, of Scranton; F. S. Hostings, of New York City, and J. H. Gilbert, of Gilbertsville, N. Y. The company has increased its capital stock from $100,000 to $200,000, $100,000 of which is to be held in the treasury. During the past month they have taken up and cancelled $50,000 worth of bonds issued two years ago.

—— The petition which has been presented to Congress asking that the superintendent of the census be authorized and directed to collect special statistics bearing on the electrical industry, in addition to the general statistics of manufacture, is one which deserves favorable consideration. What is desired, is to secure details in regard to underground and aerial construction and currents, and information relative to the different variety of lamps and motors in use, and methods of attaching wires. It is also desired to secure statistics concerning casualties from the use of electric currents, both as to fire and personal injuries. Congress has shown a commendable disposition to keep the scope of the census down, but the remarkable development of the electrical industry during the last decade, taken in connection with the fact that though it has assumed immense importance, it is doubtless only in its infancy as an industry, make it highly desirable that the information wanted should be obtained, and the taking of the census this present year furnishes an excellent opportunity for securing this information. The facts, if collected and presented in an authentic and impartial shape, would prove invaluable.

—— Mattoon, Ill., will be lighted by electricity in about three weeks.

—— The gas company is arranging to put electric arc lights into a number of stores in Rockville, Conn.

—— The Westinghouse Electric Company has installed a 750-light plant, alternating current system, at Sioux Falls, South Dakota.

—— It is reported that the plant of the Batavia, N. Y., Gas and Electric Company has been bought by S. D. Purdy, of Rochester, for the consideration of $100,000.

—— In one case, at least, gas and electric illumination have met and made friends. In Cincinnati the gas company itself is putting in an electric plant to accommodate such of its customers as desire that kind of lighting.

—— The Northampton, Mass., Electric Light Company has chosen these officers: President, Alexander McCallum; secretary and treasurer, C. H. Pierce; directors, A. McCallum, E. C. Davis, S. B. Fuller, H. A. Kimball and C. H. Pierce. The company has voted to issue $25,000 five per cent. bonds to provide for an indebtedness.

—— The Brush Electric Light Company, of Cleveland, claims that the Detroit Electric Light and Power Company is infringing on its patents. The claim of the Brush Company is based on a recent decision of the United States Court, declaring that company to be the patentees of all double carbon lights.

—— Among the contracts for alternating current apparatus for central station lighting obtained by the Westinghouse Electric Company, during the first two weeks of February, are noticed the following: Williamsport, Pa., 750 lights, increase; Butte, Mont., 750 lights, increase; Fort Worth, Texas, 850 lights, increase; Sioux Falls, Dakota, 750 lights; Pineville, Ky., 500 lights; Lexington, Ky., 3,000 lights; Creston, Iowa, 750 lights; Shidznoka, Japan, 1,500 lights.

—— The people of Dowagiac, a little town in Michigan, must be exceedingly well pleased with their incandescent street lighting system. The local newspaper, the Dowagiac *Times*, devotes over two columns of its space in a late issue to a full description of the electric light plant, and extolls the merits and advantages of the system in an unstinted manner, which caps the climax when the article states that Dowagiac is the best lighted city in the United States. The plant has a capacity of 750 lights, generated by a Westinghouse alternating current dynamo.

—— The annual meeting of the Harrisburg, Pa., Electric Light Company was held last week, and the following board of directors were chosen to serve during the ensuing year: E. J. Wallower, John I. Beggs, E. B. Mitchell, H. C. Ross, W. O. Bishop, Benj. N. Nead, H. J. Stewart, H. Cohen, T. H. Heist, H. B. Mitchell and Joseph Strouse. At a meeting of these directors, held subsequently, the following officers were elected: President, E. J. Wallower; secretary and treasurer, H. W. Stone; general manager, C. H. Kinter; superintendent and electrician, W. R. Fitzpatrick.

—— The Consolidated Electric Light and Power Company, chartered in the Maine legislature during last winter, and the New Hampshire legislature last summer, has consolidated the electric light plants of the Dover Electric Company, the Great Falls Electric Light Company, and the Rochester Electric Lighting Company, with headquarters in Dover, N. H., and power plant at the new dam, a mile below Great Falls, on the Maine side of the river. Dover, Sawyers, South Berwick, Salmon Falls, North Berwick, Rochester, Great Falls, Berwick, Gonic and East Rochester, are lighted by this system.

Development of Generating Stations for Incandescent Light and Power.

BY C. J. FIELD, OF NEW YORK, BEFORE THE KANSAS CITY ELECTRIC LIGHT CONVENTION.

I desire to present to you a brief review of the present and prospective future of central power plants in the larger cities, taking as an illustration one of the more recent types, describing its general arrangement, then proceeding to the consideration of its initial cost, earning capacity, output, operating expenses and economy, and in conclusion, trying to indicate the immediate future development in this class of work.

CENTRAL STATIONS.

The immediate points to be considered and carefully weighed in the designing of central power plant for a large city are many, and they should receive careful survey before any work is proceeded with. We will briefly summarize them as follows:

First. Recognition of the importance of safety and reliability in operation.

Second. Obtaining the true economy of output under all conditions.

Third. Installing of plant in a building entirely suited to the working of same, and as far as human ingenuity can provide, proof against destruction.

Fourth. Adaptability to proper and economical working of the plant.

Fifth. Division of the generating power into the proper number of units for the safe and reliable operation of the plant.

Sixth. Flexibility of system, that is, adaptation to furnishing current for light, power and other sources of revenue; the obtaining of the largest return per dollar invested, and not carrying to excess for the mere sake of engineering by any part of the plant for the obtaining of proper results therefrom.

Seventh. Not installing the plant for mushroom growth, but laying it out for comprehensive business, thereby securing, at as early a date as possible, the entire confidence of the invested capital.

A true and careful consideration of these points will prevent trouble later on. Much of the trouble of stations at the present time, in their standing with the community, is due to neglect of this point, and the majority of their failures as well. We have got to recognize the fact that the public, to a certain extent, have become prejudiced, in a measure, somewhat unjustly, but this is all the more reason for better and more conservative management, and giving them good construction. No more inviting field is offered for either investing capital or good engineering than central station for lighting, power and railway work.

A REPRESENTATIVE STATION.

I propose to take as a representative type, showing the present development and first-class work, the station of the Edison Electric Illuminating Company, of Brooklyn, which was completed last fall and is now in successful operation. With the aid of illustrations which are included here, I will give a general outline of the arrangement of this plant and apparatus used.

In the arrangement of this plant there was somewhat of a departure from previous general practice in this line, the company trying to secure the benefit of past experience in the larger stations of this class, both in the arrangement and kind of apparatus used, trying to secure at as economical a cost as possible, the best plant for the purpose. As will be seen by the longitudinal section through the building, the general arrangement is as follows:

The boilers and engines are located on the first floor, the engines being on the front half and the boilers at the rear, thereby bringing everything on this part directly under the eye of the chief engineer, making it much better than where the boilers are located two or three stories up; this was obtained by spreading out a little more on the ground. The boilers are Babcock & Wilcox's largest type of sectional water tube boilers. The engines are 300 horse power, compound, horizontal, automatic engines, manufactured by the Ball Engine Company. Each engine is directly belted to two generators. The plan of the engine and boiler room floor will also show in more detail the general arrangement here used, and, I think, needs no further explanation.

Ascending to the second floor, we reach the electrical part of the plant. Here are located in the front part of the building, directly over the engine room, 24 dynamos, each with a capacity of 750 amperes and 140 volts. Each dynamo weighs about eight tons. Overhead traveling cranes are installed here and in the engine room for ready and quick handling of all apparatus. Through the center of the dynamo room is located the electrical gallery. From here are controlled the workings of all the dynamos and other apparatus, also all outside lines. Everything in connection with handling, generation and furnishing of current, is directly under the eye of one man in this gallery, and from which he has a general view of the dynamo room floor and the workings of the dynamo, a second man being on the floor to see to the bearings and brushes. From this gallery run all the feeders, which connect into the net-work of mains, covering over an area of about one and one-half miles square. The ampere meters are located on each feeder, so as to show the load in each part of the district. This plant maintains its distribution and regulation thereof by balancing within itself. No feeder equalizers are here used for feeder regulation; the uniting and tying up of the system together with the auxiliary bus affects this regulation. All circuits of this plant are underground, there being about 25 miles of underground conductors. These have given perfect satisfaction and reliability in their workings, maintaining to-day an insulation on the system as a whole of over half a megohm.

On the rear of the second floor are located the coal storage, water tanks and feed water heater. On the top floor we have the offices, supply rooms and workshops of the company. Returning down stairs again, we find in the basement ash pits, smoke flues, pump room, two large coal storage vaults, giving a total capacity for storage of over 1,000 tons, air blast for force draft, and other details in connection with the steam plant.

We have, therefore, here, in a building 75x100 feet, apparatus and all departments complete for the generation and supply of current and power for a capacity of 40,000 lights, or the equivalent in light and power, and so arranged as to secure, as far as can be foreseen, continuous working of the plant, and entire reliability in the furnishing of its current. It is only thus that we can hope to obtain a business and establish ourselves on the commercial basis which gas light companies have placed themselves in the past years, and thereby secure to our stockholders the returns for which they have invested their capital.

Having thus generally outlined this plant, we will now turn our attention to the consideration of other points in connection with it. One of the most important items is the cost of such a plant. I give you below, in round figures, the cost as shown by the construction accounts and estimates:

Station building, complete, including all fittings, foundations, stacks, etc.	$100,000
Real estate	36,000
Steam plant, including engines, boilers, pumps, heaters, piping, bells, etc.	50,000
Electrical plant, including dynamos and all electrical apparatus, as switches, etc.	40,000
Underground system, material	115,000
Excavation and labor installing same	35,000
General, including lamps, meters, tools, instruments, engineering and architectural expenses, wiring, services and office furniture	50,000
Total	$426,000

This includes the entire cost for the plant as it stands to-day, which, as far as the building is concerned, is complete for the entire capacity. At present there is installed generating capacity of boilers, engines and dynamos, for one-third of the final output of the plant. The electrical apparatus is complete for the entire output, with a very few additions in the way of a few switches, etc. The underground lines have a capacity for 20,000 lights. The work necessary to complete the plant for its entire capacity would amount to about $200,000 additional.

For this amount there has been obtained here a plant, which is considered equal, if not superior, to any of this class, and at a cost of 20 to 30 per cent. less than is expended for similar ones.

I will take up the next consideration of the operating expenses of such a plant. In order to place the company on an earning basis, we have to secure to start with a certain number of lights, or an equivalent in lights and power to clear the necessary general and operating expenses, which will exist regardless of the smallness of the load; in other words, we must have for such a capacity plant not less than 5,000 lights, with an average income of $8 per light per year, to clear the general incidental and operating expenses.

This figure we may consider as our unit of operating capacity. From this we can figure the increased earnings and profits for the larger number of lights connected. There exists practically a constant ratio of variable and fixed operating expenses. By variable expenses, we mean those obtained on a variation in load and increase of business; this includes coal, oil, lamp renewals, and small increase from time to time in the amount of labor employed. The fixed expenses include those items which remain practically constant under varying conditions of income. A careful analysis of all the items covered in these expenses in such a station as this one, gives the following result: That the fixed expenses are 75 per cent. of the whole, and the variable 25 per cent. approximately, or in language which may appeal more directly to you, if we double our income or business, we only increase our expenses 25 per cent. This shows that a station's possibilities and profit lie in increasing this business from the unit point.

The average income per light in stations of this class vary in different parts of the country, and with different loads.

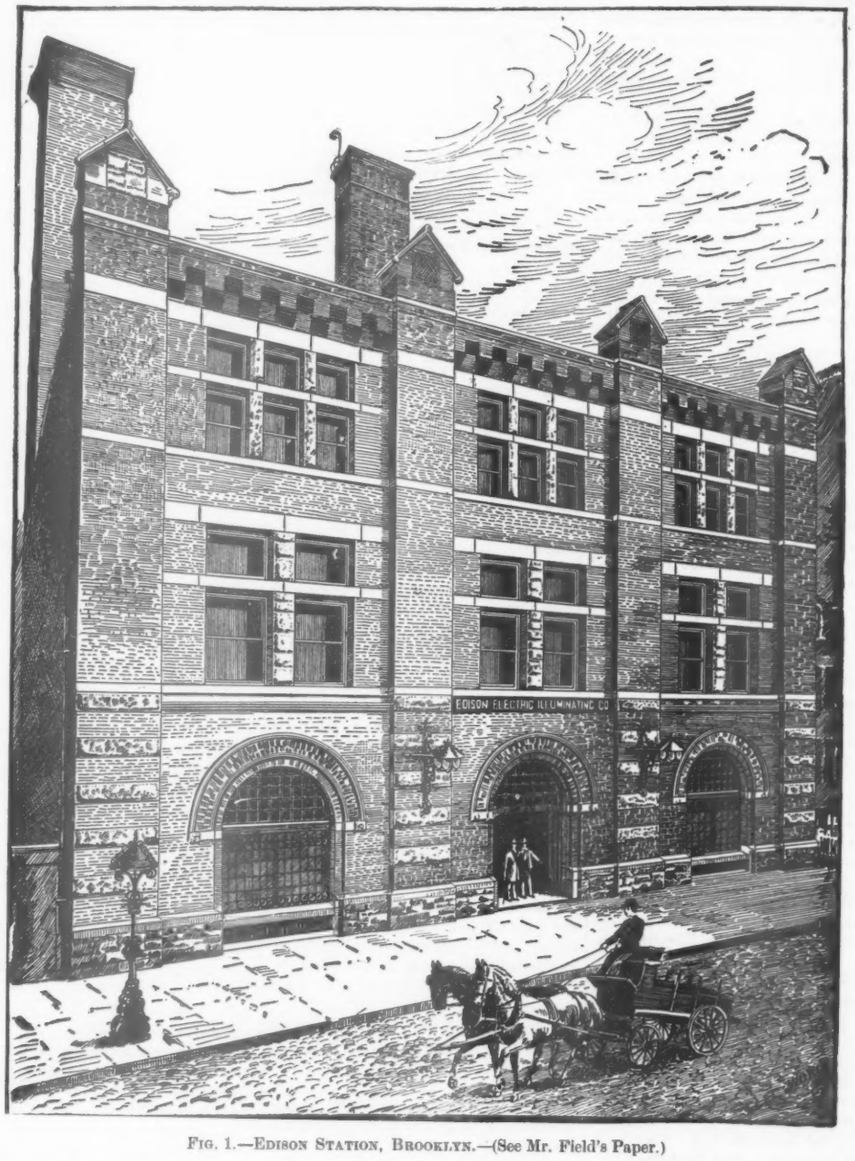
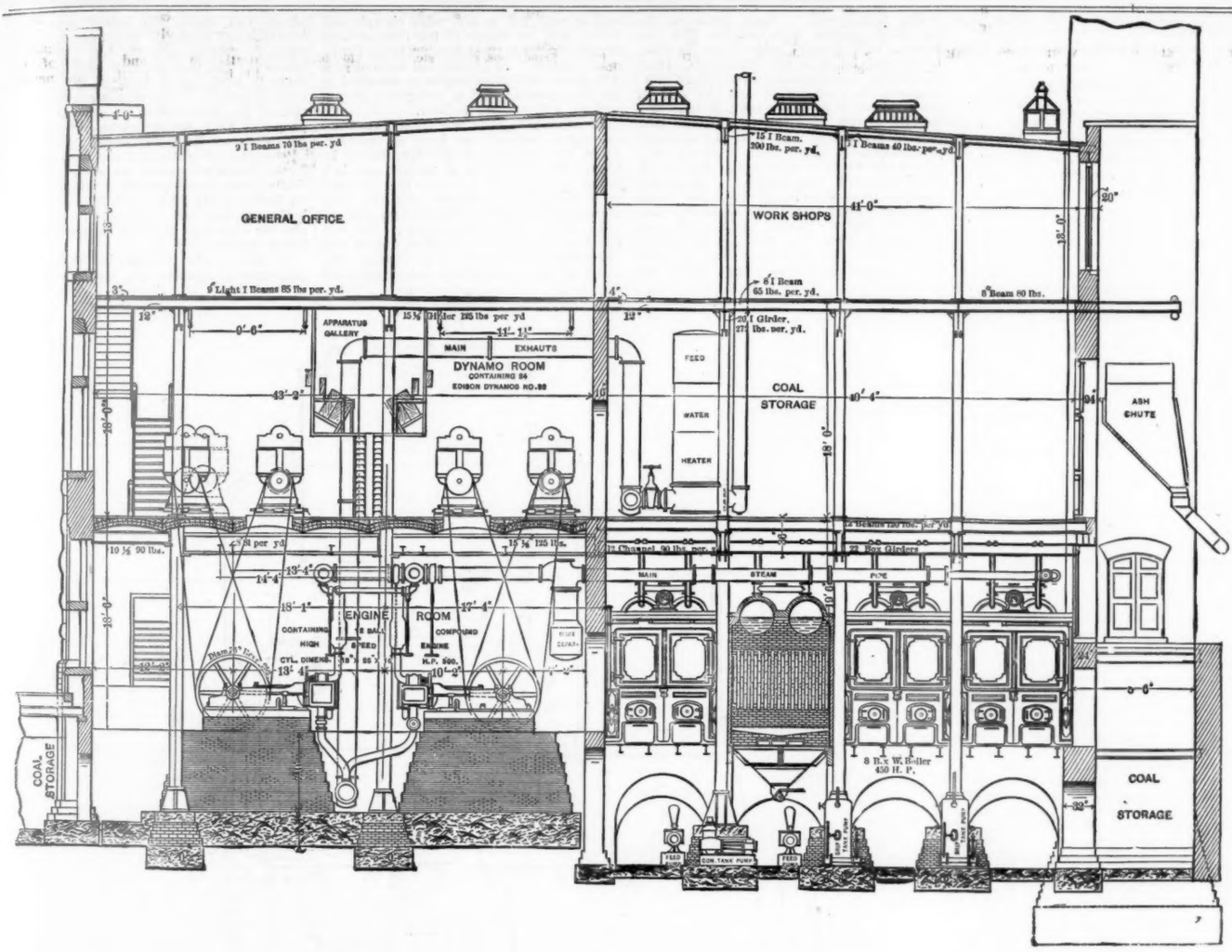
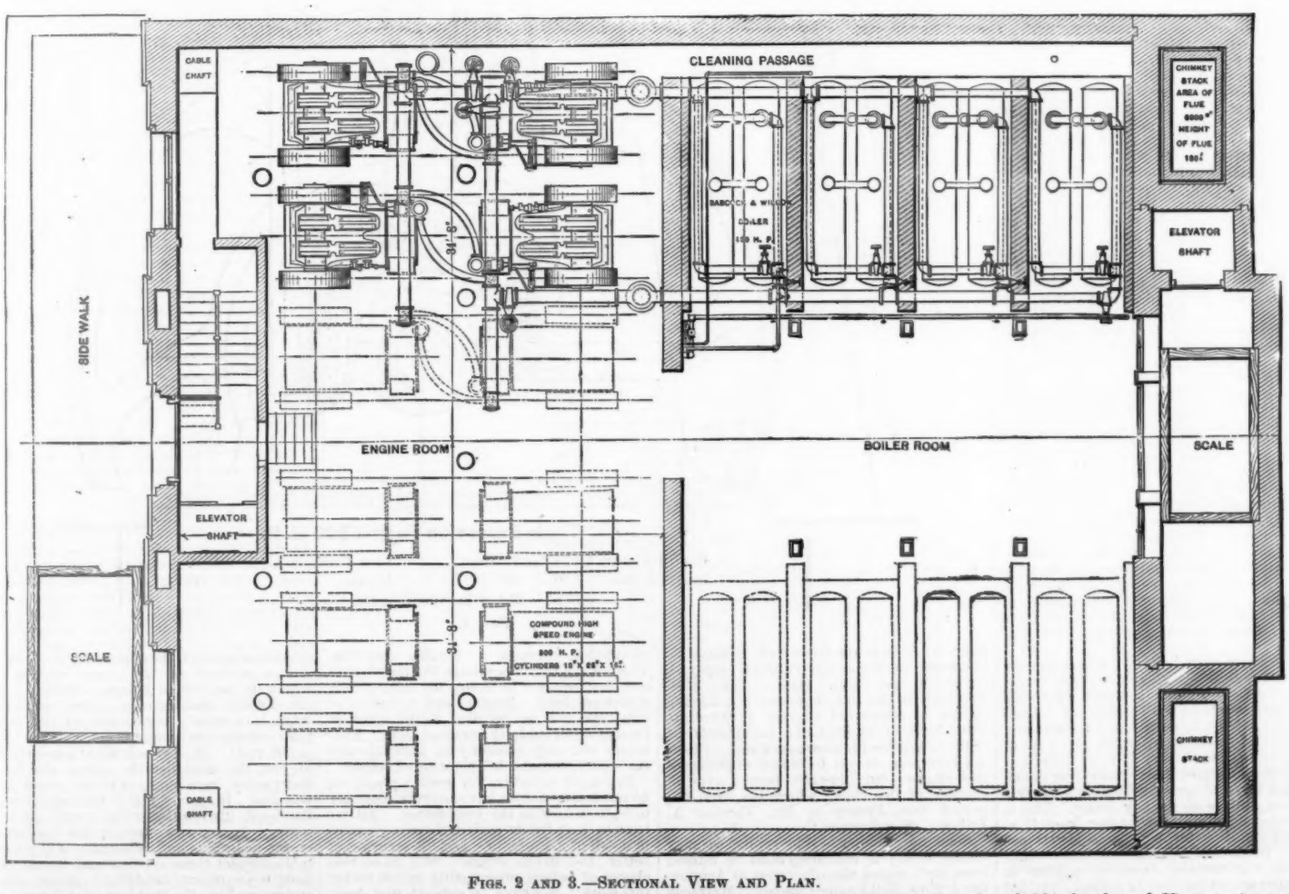


FIG. 1.—EDISON STATION, BROOKLYN.—(See Mr. Field's Paper.)

We have illustrated a load diagram taken from this station, which gives you a fair idea of the changes and variations here taking place. The maximum number of lights lighted at any time in proportion to the number connected, is very good for such work, and shows a good class of business. The load diagram through the day, however, shows a new station on a clear day with a small number of lights lighted, and power work only just commencing. It is this power work that wants attention, and the securing of which means the bringing up of this average load during the day-time to a good paying basis. The curve for the evening hour indicates a good, broad, solid load, which shows the combination of six o'clock business with the addition of a good solid evening load. Many stations after reaching the maximum point around six o'clock, rapidly fall off and never regain this point again for the evening. Here we have the illustration of clubs, theatres, churches, concerts and residences, lighting after supper, bringing up the load to its maximum point between eight and nine o'clock. The average





FIGS. 2 AND 3.—SECTIONAL VIEW AND PLAN.

load for the 24 hours, which is about 25 per cent. of the maximum, is a very fair one, and with the addition of the day load that will come on with the addition of power, will make this a model load diagram. The general run of stations shows as an average for the 24 hours, from 20 to 40 per cent. of the maximum load; the latter figure is very seldom reached. The writer knows of one station in which we have the latter figure, and where, if we eliminate one short half hour around six o'clock, we have the remarkable showing of 75 per cent. average load for the 24 hours.

I also wish to illustrate here some remarkably fine indicator cards, which show the

workings of the engines of the steam plant in this station.

The division of work shown on the cylinders is as follows:

I. H. P. head end high pressure cylinder	$63\frac{5}{16}$	H. P.
I.H.P. crank end high pressure cylinder	$60\frac{3}{16}$	"
I.H.P. crank end low pressure cylinder	$59\frac{3}{16}$	"
I. H. P. head end low pressure cylinder	$55\frac{3}{16}$	"
Making a total I. H. P.	$238\frac{4}{16}$	H. P.

with a boiler pressure of 110 pounds, revolutions 223 and load 1,200 amperes, which is the equivalent of 2,725 lamps, therefore giving for the indicated power furnished, eleven and one-half lamps per horse-power. This is for power developed, making no allowance for friction of engine and dynamo. The friction of the engine is less than five per cent. of its normal capacity.

Having in the above given a general outline of this plant, its cost and operating expenses, I now wish to call your attention to the points in connection with the type of engines, boilers, dynamos, underground system, etc., to be adopted in a station of this class.

"CONCLUSIONS."

We will first consider the question of the engine. As already stated, in proposing the engine power of a station of this kind, we first have to consider the question of using either the Corliss or high-speed engine. Regarding the use of Corliss engines in a plant of this kind, we are frank to state our objections. Excessive first cost, ponderous machinery, counter-shafting, pulley, clutches etc., lead us to believe that these things are unnecessary when the problem is carefully considered from an unbiased standpoint. What we are after is results; not theory, but actual practice. Assume, for the sake of argument, that we can save five or ten per cent. in steam economy, if this is obtained at a cost, the interest of which amounts to more than this, we are obtaining it for no good whatever; furthermore, there are many other problems in electric light stations which we have to carefully consider in this question of steam plant, one of which has been enumerated before, the question of reliability in operation, and always being ready for service. One of the latest types of stations combining arc and incandescent, where we have the Corliss engine in all its perfection of detail and apparatus, is that of the Narragansett Company, in Providence. If one will carefully look over this plant, as I had the pleasure of doing a short time ago, with others, and consider all these problems carefully, and then examine a station similar to the Brooklyn one, I think he will be forced to admit this fact. We want to obtain our power as direct from the engine to the dynamo as possible, and at the same time as cheaply, and obtain the best economy under the variable loads that we are going to have. We cannot design our plant for that capacity which is reached, as shown on our load diagram, for only a short time in the 24 hours, but we must so design it to give this result for the average that we have during the 24 hours. Even where we have a more constant load, as in exclusive arc lighting on municipal circuits, I think even here we need to carefully consider the problem as well.

High-speed engines, so called, although they are not in piston speed any higher than the Corliss, but merely in rotative speed, have shown a considerable development and marked advance in the past year, and the next year is going to see even more development in this line. Owing to better workmanship, better designing and building than formerly, the prejudice which largely existed among old engineers against this type of engine, is rapidly wearing away. With the single cylinder engine, under variable load, we often obtain poor economy, but, as compared with the Corliss, under similar conditions, allowing for the discrepancy in price, the result is not so disparaging. Now they are going further, and building compound and even triple expansion engines of this class. In the Brooklyn station we have one of the representative types of this class of engines, being horizontal, compound engines, which we here illustrate to show their general design in more detail. (See diagram.)

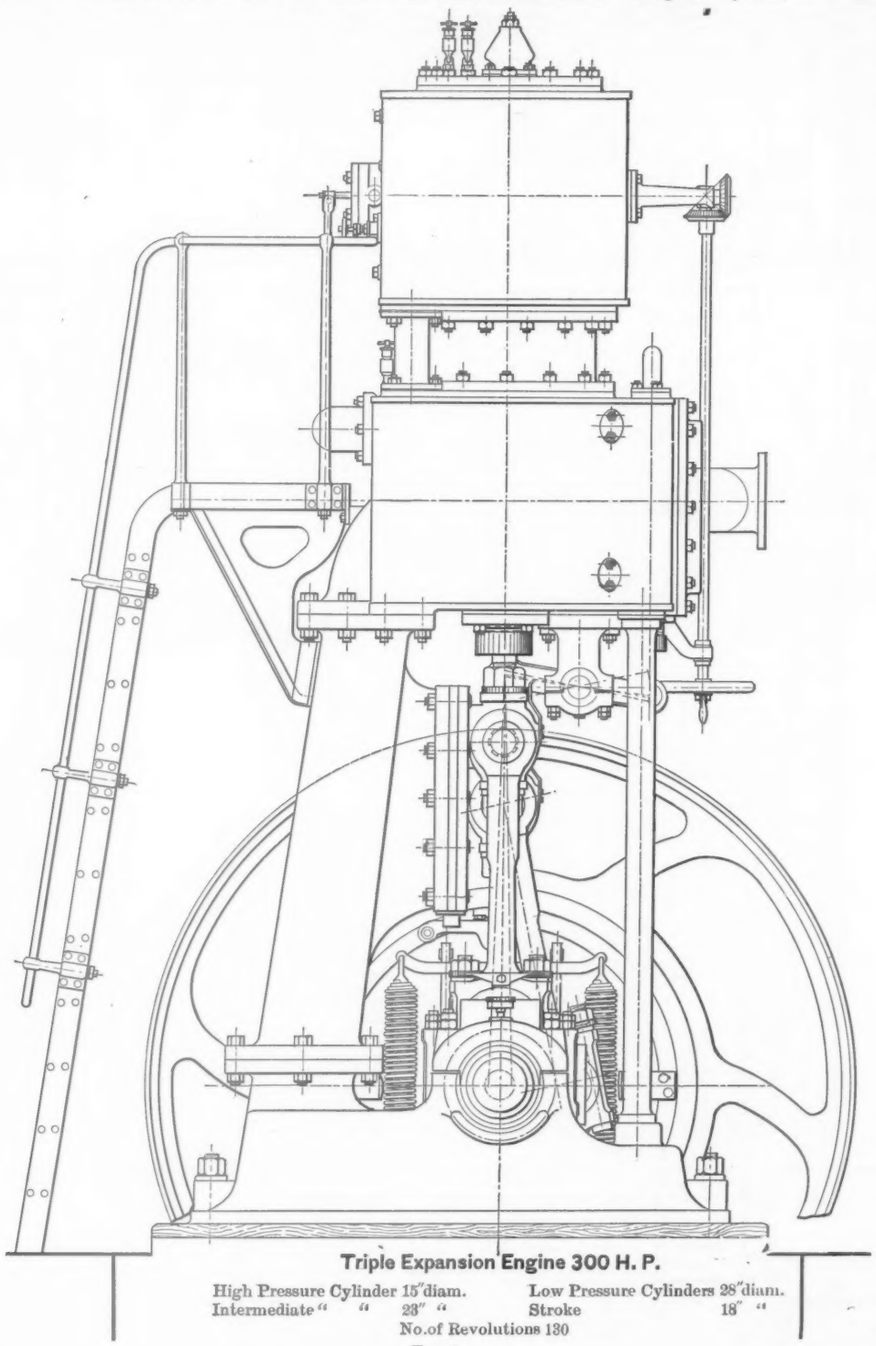
These engines are built for higher economy and economical work, and the guarantees made on them I think compare favorably with the guarantee on compound Corliss engines; at least three or four of the manufacturers of this class of engine stand ready to-day to guarantee from 22 to 25 pounds of water per indicated horse-power per hour. I do not know of any Corliss manufacturers who are willing to do any better. This is for non-condensing, condensing from 17 to 18 pounds of water per horse-power per hour. Engines of this class are as well built now in workmanship, and as reliable in operation as can possibly be desired. Added to this, we have the advantage of direct connection to our generators, avoiding all the intricacies of shafting, etc., and the unreliability they entail. Tests made at the Brooklyn station have shown that the engines have actually come up to the guarantee made on them, and that the plant there is showing, as compared with single cylinder engines, an economy of coal per unit of output from 25 to 30 per cent. better. In a station of this kind, the actual coal consumed per unit of output at the dynamos is considerably larger than is shown on a direct test where we charge the engine only with the coal it uses directly. The weekly records from stations of this class charge the horse-power output with all the coal used by the engine, pumps, condensers, well pumps, cleaning fires, blowing off boilers, etc., and where the former item is about three pounds of coal per horse-power per hour, we have in the latter case, making no allowance for the engine running empty, a result 50 per cent. greater than this. Economy in this line, however, is not going to stop at compound engines, as there are being built by at least two manufacturers, triple expansion high-speed engines. I have not been able as yet to obtain drawings of this engine, but illustrate here a type of engines of this class, which has been imported from France by Mr. Thomas A. Edison. (See diagram.)

Something similar to this is what we may obtain to-day if encouragement is offered from such engine manufacturers as Armington & Sims, Ball Engine Company, McIntosh & Seymour, and others. We are coming to a recognition of the fact that if we want the high economy, we can obtain it as cheaply and as well, not to say more cheaply and better, with an engine of this class as with engines similar to those installed in the Providence station. In guaranteed economy, it will equal the Corliss engine as installed in the Narragansett station, and give it to you under a wider range, the load.

In connection with the triple expansion engines mentioned, we have to consider, again, the problem of the dynamos to be used. We can stay as at present, and belt to our dynamos, but I believe that the next large incandescent stations will not only include compound or triple expansion engines of 200 or 400 horse-power, but will also have multi-polar dynamos, one or two being directly connected to the engine. By this I do not mean belted, but direct shaft connection through a flexible coupling. This, of course, necessitates the multi-polar machine, in order to secure the output with a slower speed. Engines and dynamos of this type can be installed in the space at present occupied by the engines alone. This means not only economy in building and real estate, but also in operating expenses.

In regard to boilers for such a plant, we do not know that we have any new economy to be hoped for in the near future. All we have to look for at present is improvement in detail of manufacture and the securing of better and dryer steam. We have two classes of boilers prominently before us for this work. We have, in general, first, horizontal tubular boilers, which we find in general factory use, to a large extent, throughout the country. Where we have plenty and cheap real estate, poorer attendance and moderate steam pressure, this class, in general, fills the bill. We find, however, that they are now even building them to work up as high as 125 pounds boiler pressure. When we come to construction of the boiler plant on expensive city property, where we are cramped for space, we are almost limited at once to some one of the types of sectional water tube boilers. In the Brooklyn station, we are practically limited to the consideration of this class, and we have not only 125 pounds, but 150 pounds boiler pressure, and even higher. We have also the advantage of quick steaming under heavy changes in load.

We have, to-day, brought before us in the underground systems, the consideration of what is to most of the companies their most serious problem, in the proper solution of which the best talent is being devoted. In the Edison underground system we have what is generally recognized as the most practical solution for circuits of less than four to 500 volts. We here obtain at a minimum of cost the most flexible system and local distribution from house to house, which has no equal. It enables you to take off services for local distribution from every 20 feet without in any way affecting the insulation on the main line, and being able at any time to disconnect these services and restore the main to its original condition. In any other system we have the problem of splicing and cutting of cables, which, at its best, is bad work. What we desire is not so much a high insulation, as good, mechanical protection.



Triple Expansion Engine 300 H. P.

High Pressure Cylinder 15″diam. Low Pressure Cylinders 28″diam.
Intermediate " " 23″ " Stroke 18″ "
No.of Revolutions 130

FIG. 4.

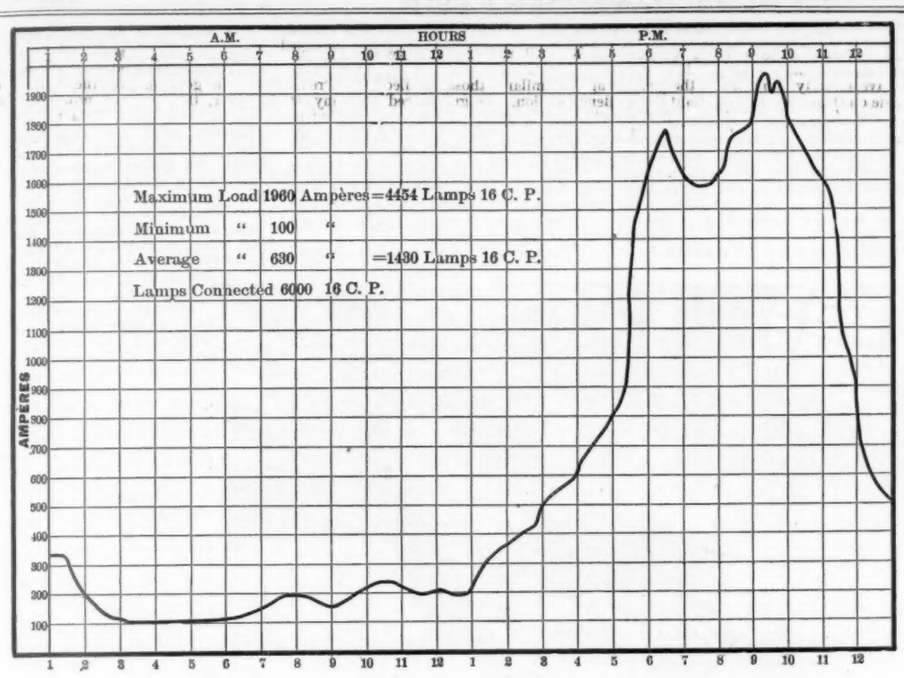

A.M.
HOURS
P.M.
Maximum Load 1960 Amperes = 4454 Lamps 16 C. P.
Minimum " 100 "
Average " 630 " = 1430 Lamps 16 C. P.
Lamps Connected 6000 16 C. P.
AMPERES

FIG. 5.—LOAD DIAGRAM.

As long as we can hold a moderate insulation with good mechanical protection, that is all we want. In Paris they have used bare copper conductors, supported on porcelain in a concrete conduit. This has worked satisfactorily in the main, but, of course, are very expensive. They are now proposing for all their increase, the Edison tubing for this class of work. In any system of cables drawn in we have the selection of a large class of conduits, but in my mind all we need and desire, as I have before stated, is mechanical protection for these cables, and the cheapest conduit that will afford this protection is all that is necessary. What is wanted especially is some system of local distribution for these higher tension circuits. The underground system installed in Brooklyn has a network of underground conductors in the mains and feeders, of over 25 miles. This entire system is so arranged, distributed and connected in a network that, with a drop or resistance of one per cent. on the mains and ten per cent. on the feeders, we are able to maintain in the system practically a perfect regulation in the distribution of the current. This system stands to-day representing one of the most complete and perfect examples of work of this class. The largest problems that we know of in underground work are the proposed new extension of the Edison Company in New York, and the underground system of feeders proposed to be installed for the West End Railway, of Boston. The copper alone for the latter amounts to over $1,000,000; and this question of the cost of the copper calls my attention to a fact which I desire to notice, that much of this question of bugbear on copper is uncalled for when we are considering the underground system. The entire copper used on the system in Brooklyn is less than one-fifth of the cost of the underground system first installed.

I do not desire to claim that the ideas for the class of work here represented and described, hold or represent all the perfection to be obtained in central station work. There are many points contrary to the ideas here outlined, which are very desirable. I have merely tried to call your attention to what I consider good work in this particular line, and hope that it will result in bringing forth the discussions and additions which are very beneficial in the consideration of these problems in the results to be obtained, and I would only add a tribute to the powerful and master mind whose work, from the commencement of this field of central station distribution, has covered the leading problems and points, and whose ideas to-day represent much of the good and very little of the bad problems which we have in this work. I refer to Thomas A. Edison, whose work, commencing in this field on the old Pearl street station in New York, over eight years ago, when the majority doubted, and but few believed in its successful carrying out, and while we find that station until within the past few months, when it was partially destroyed, successfully working, and even antiquated as it was, earning large dividends. He has still continued actively to impregnate his ideas on the work from that day to this, although he has not taken such an active part in its carrying out, but I think we may see him at no distant day, again taking a hand in this work, and bringing forth many new ideas in advancing the progress of the future.

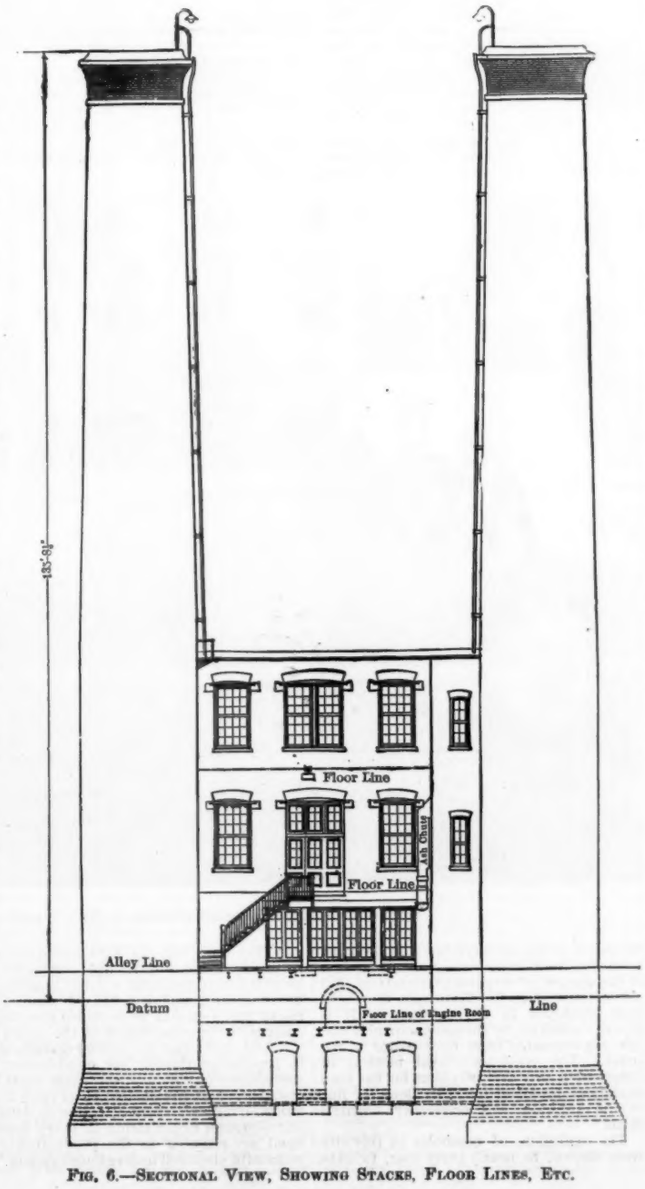


FIG. 6.—SECTIONAL VIEW, SHOWING STACKS, FLOOR LINES, ETC.

The Steam Engine.

BY FRED. E. SICKLES, AT THE KANSAS CITY CONVENTION.

This paper on a subject of never failing interest was presented during the second day of the Convention. Mr. Sickles did not dwell upon the theory of the steam engine, but proceeded at once to point out some of its mechanical defects, though no patented devices were criticised by him. All devices which have yet been used to admit and exhaust the steam from the cylinder have their especial defects. The whole subject of valves for steam engines presents a field for ingenuity. Mr. Sickles next took up the trip cut-off valve with which his name has been identified for over half a century and gave an interesting account of its application to the steamer "Pilgrim," of the Fall River Line.

In most cases, dependence has been placed upon what is termed cushioning to make the engine work smoothly, by shutting the exhausts before the completion of the stroke and allowing the steam yet remaining in the cylinder to be compressed. It may be said that all high-speed engines of the present day use this plan to avoid pounding on the center. Locomotives and high-speed stationary engines depend upon the compression of steam to avoid a pound in the reciprocating parts. This compression necessarily absorbs a certain portion of the power of an engine, but it can be relied upon to secure smooth working.

The speaker remarked that the steam engine and all its parts were, as yet, far from perfect. Piston packing was discussed at some length and it was said that mechanics were almost in despair of producing a perfect piston packing. "A realization of the imperfection of any machine may lead the way to make an improvement upon it; it is therefore instructive to search for defects in the steam engine."

A perfect lubricating arrangement for the journals, one that can be relied upon in all cases, has yet to be made. The speaker hoped to see the day when we would have the ideal or universal steam engine; that time had certainly not been reached as yet.

The constructing engineer is constantly harrassed by the questions: "Who is to take care of and run this engine which I am now planning?" and "How far can I rely upon efficient attendance?" And as often as he decides these questions, he decides, to some extent, the character of the engine which he considers best for the purpose. The governor was critically treated and some of its chief defects pointed out.

"The cultivated human eye and ear are wonderful natural indicators to determine the working of many parts of a steam engine. By watching any moving part of the engine and listening to the sound of the steam in the steam pipe, a good idea can be formed of the point of cut-off. By a closer attention to the peculiar sound of the rushing steam, the efficiency of the cut-off can be partly determined. By listening to the sound of the exhaust and watching the crank pin, a good idea can be formed of the lead; then by a closer attention to the peculiar sound of the exhaust, such as the time during which it can be heard, a fair idea can be formed of the exhaust line as it will appear upon the indicator card in this case.

"The human touch will reveal relative motion in contiguous parts of machinery that is beyond detection by the eye or ear, as by placing a finger on two pieces that are apparently firmly in contact, a motion will sometimes be felt that is not visible."

The speaker explained that it was difficult to treat of machinery by words alone, without the assistance of drawings, and deplored the fact that the dictionaries do not give to mechanical terms the meaning as understood by the mechanic.

Hear the Opera for a Nickel.

The Automatic Phonograph Exhibition Company, of New York City, was incorporated in the Secretary of State's office at Albany last week, with a capital stock of $1,000,000. It is formed to manufacture, lease, use and sell, a nickel-in-the-slot machine, by means of which the dropping of a coin in the slot will operate a mechanism which will cause a phonograph or phonograph-graphophone to reproduce the sound recorded upon its cylinder, and after such reproduction cause the diaphragm to return to its original position. The trustees of the company are Felix Gottschalk, Willard L. Candee, Thomas T. Eckert, Jr., Richard W. Stevenson, Victor E. Burke, John G. Prague and James Molinari.

The Practical Working of the Electrical Subways in New York City.

At the last meeting of the American Institute of Electrical Engineers, a paper under the above heading was presented by Mr. Wm. Maver, Jr. After a few preparatory remarks, the lecturer stated that, in New York city to-day, there are 73 miles of electrical subways and 1,017 miles of ducts. In these ducts are 10,906 miles of telephone wire, 945 miles of telegraph wire, including fire alarm telegraph wires, and 457 miles of electric light wires. These subways have a capacity for about 45,000 miles of telephone and telegraph wires, and 2,000 miles of electric light wires. In the New York subways there are eight different conduit systems, namely, the Dorsett, the Wyckoff, zinc tubing in hydraulic cement, sheet iron cement lined pipe, wrought iron pipe in hydraulic cement, wrought iron pipe in asphaltic concrete, the Edison iron tube and the Johnstone sectional cast iron conduits. The descriptions of these conduits are familiar to our readers.

Access is had to the conduits by means of manholes placed at an average distance of 1¼ miles apart. The manholes are, with few exceptions, built of brick laid in concrete cement, and coated on the outside with cement. In most of the systems the cable is inserted by a process technically called "rodding," that is, pushing rods through the duct from one manhole to the next. A rope is attached to the rod and the cable to the rope. The cable is then drawn in by means of some form of winch.

Various systems of distribution from the main trunk line cables have been used, the Johnstone system being probably the most largely employed. Our illustration gives a good idea of this conduit. This system has been found of much utility in the practical distribution of electric light current in this city.

In the telephone service the cables used are chiefly of the type known as the Patterson, having an electro-static capacity of about .16 microfarad, and an insulation resistance averaging about 100 megohms, as the cable is used in the subways. The longest stretch of telephone cable is seven miles, and the greatest number of conductors in any one cable is 100 or 50 pairs. The telegraph companies have thus far used chiefly for underground service okonite, standard underground, kerite and Patterson cables. The average number of conductors in the telegraph underground cables is about 50; the size of the wire used is, as a rule, No. 16, B. W. G., and the outside diameter of a conductor, including the insulation, is $\frac{1}{16}$.

In the electric light service, there are, exclusive of the Edison system, four different types of insulation used, namely, the Bishop rubber compound, the standard underground, the safety insulated, and the Cobb vulcanite paraffine cable. The present condition of the majority of these cables, which have been down from one to three years, is very satisfactory. The methods employed for locating faults in electric light conductors in the subways, is to test the conductor from point to point, until the defect is placed between two lamps or manholes. If the defect is in the cable proper, the section is withdrawn, and a new section substituted. With the Edison conductors, access is had at the ends of each pipe by removing the paving and earth about the pipe. The Dillon joint, and the Cobb joint, have been suggested for use, as they render the ends of the cable accessible.

Concerning the durability of cables, the lecturer did not think that sufficient time had elapsed, so that a definite judgment could be formed. Specimens of cable which have been in service for nine or twelve months, show no physical or electrical deterioration. It would appear that lead-covered cable is preferable for underground use.

There are no concentric cables in the subways in this city. The mains of multiple arc circuits are operated in separate lead covers in the same duct. It is contemplated by one of the companies to use one lead cover for such circuits hereafter.

Mr. Maver dwelt at some length upon the importance of making good joints, and urged the necessity of employing efficient men to do this work. The use of a lead covering on the cables is not required by the subway rules, but for many reasons the companies have adopted it of their own accord.

"It will hardly be credited by some people, but it is a fact, that live electric light wires conveying the alternating high tension arc currents, are handled and moved about in the manholes by means of the lead covering, without the slightest indication that such wires are alive."

The high tension circuits are tested weekly with a Thomson reflecting galvanometer, and, as a rule, 100 volts chloride of silver battery is employed as a testing battery. The subject of testing the underground cables was treated in considerable detail.

On some of the circuits a lightning arrester is used, known as the Acheson cable protector. These are intended to protect the cable against disruptive discharges from any source. "As regards the accidents to workmen in the manholes, due to contact with live wires, no one will say that such occurrences are impossible, but inasmuch as not a single accident of this kind has occurred in New York city, or, so far as I can learn, elsewhere in electrical subways, it is fair to assume that with the exercise of proper supervision of the wires this is not likely to prove a frequent source of accident." Whatever may be the dangers, stated and unstated, so freely predicted as liable to occur with the wires underground, it may be certainly said that men will not be injured by falling off poles in the subways. Wires, when in the subways, during the prevalence of sleet storms, will not fall upon people or horses in the street, nor be torn down by elevated trains, street cars, etc., etc.

"In my opinion, the presence of gas is the most serious defect of the electrical subways in cities; of course, it is not an inherent defect in the subways, but it is nevertheless a very troublesome one—not only because of the danger of explosions therefrom, but also because of its ill effects upon the workmen employed in the subways." It is actually admitted by the gas companies that this gas emanates from their mains in the street. The most successful method of overcoming this difficulty thus far has been to station blowers at intervals along the line of the subways and artificially ventilate them.

The explosions of manholes in this city were shown, in nearly every case, to have been due to other than electrical causes.

"In conclusion, I think it may be said that the experience derived from the practical operation of the electrical subways of New York city has either made apparent, or confirmed among other things, the following:

"That it is possible to successfully operate all classes of electric conductors underground in cities.

"That, at least for conductors conveying high tension currents underground, it is advisable to set the standard of insulation high.

"That regular insulation tests of the conductors are very valuable.

"That liberal thickness of insulation is desirable for high tension currents.

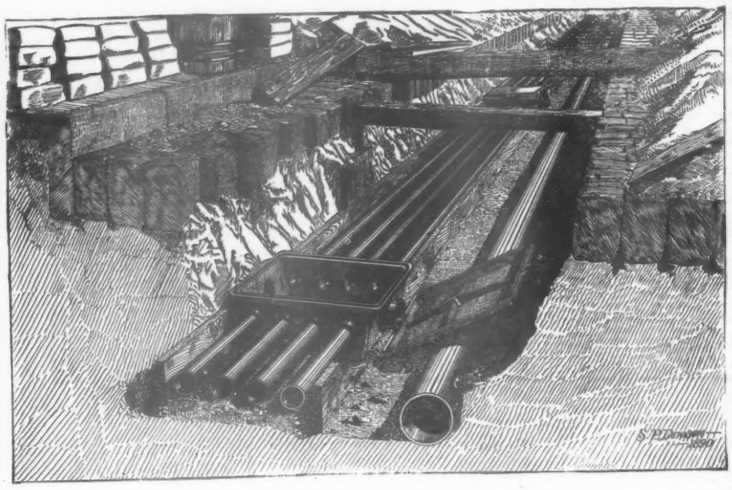
"That it is unadvisable to place underground new types of cable or insulation until they have been subjected to tests and conditions analogous to those to which they will be subjected underground.

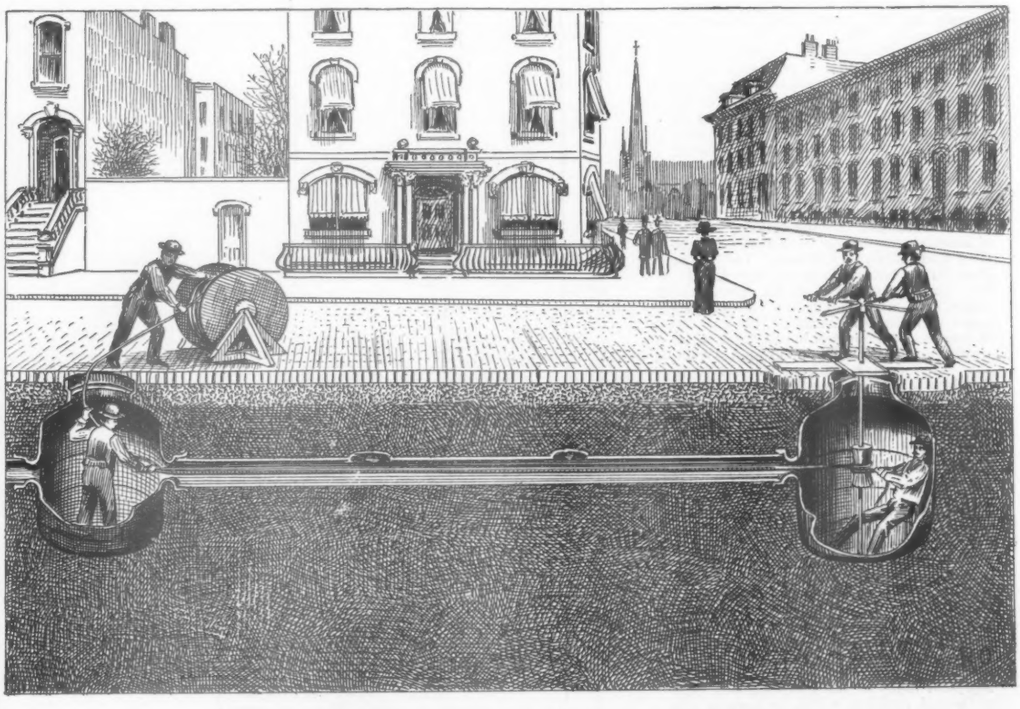
"That for electric lighting conductors—especially distributing mains—many conductors under one cover are not advisable owing chiefly to the difficulty in making joints in such cables.

"That all sharp edges in ducts should be avoided.

"That until the gas light companies are required, like the electric light companies, to maintain their mains in a fairly sound condition underground, a means of ventilating the subways should be provided simultaneously with the construction of the subways.

"And, lastly, that while other features may be accessories thereto, the employment of smooth, strong conduits, accessible ducts for distribution of the current, first-class insulation, constant expert attention to details, and thorough organization in every department, are essential to the production of a successful electrical underground system."





VIEWS OF THE UNDERGROUND SYSTEM OF NEW YORK.—(See opposite page.)

A System of Station Accounts.

BY T. CARPENTER SMITH, AT THE KANSAS CITY CONVENTION.

Having asked and been asked many times as to the cost of producing electric lights, and having received and given answers which varied widely, without having any means of reducing them all to a common denomination, I have thought that some system of doing work and keeping cost might be devised which could be used in stations of any size, and at the same time enable us to make fair comparison between them.

To do this it means that we ought to have some general principles of doing work and carrying on the routine duty of the station, which principles should not be burdensome to stations of small capacity, but the details of which would be elaborated and the station increases its business, until it could fairly result in a company being able by a simple inspection of its books to tell what it costs to do its work from day to day, and on just what items of its business it was making or losing money.

We all know that in the electric light business there are certain contracts which must be taken and which must be done, from which no real return can be expected, and the problem is to know just how much we make our losses on each particular contract, in order to decide quickly whether the "game is worth the candle" for such cases. To find what is necessary to be done in the highest development of this method, I think the easiest plan will be to describe a system organized some years ago, which has stood the test of time and service, with the need of but few changes.

I do not wish to be understood as claiming that this system presents any great originality, since the most of it is only the application of methods of carrying on business which have been marked out from time to time. The application of some of these methods, however, to electric light station work is, I believe, new.

The first main principle is dividing the staff into two distinct branches—the station and the office. This may not seem practicable in small stations, but I would explain that this has reference simply to the official capacities of the men.

In small stations it is very likely that one man will be a sort of "Pooh Bah" who fills many offices, but the lines of duty must be kept clearly distinct from one another. Without doubt all companies have been more or less annoyed by the continuous waste of time and money from customers sending complaints to the station of having little odd jobs attended to for which they never think they should pay. For such service it would cost the company more to collect the money due than the whole affair is worth; at the

same time one does not want to run the risk of offending an otherwise good customer by refusing to do an apparently trifling service.

By separating the office from the station, and having all complaints sent to the office, it simply makes it not quite so easy for the customer to demand anything of this kind, and any employé of the station who is doing work in a customer's establishment has for an answer to any request to do something outside of his regular duty, that he cannot do it without an order from the office, at the same time saying that no doubt that it will be all right if the customer will make proper application.

The office, can very easily, when such inquiry is made, volunteer the suggestion that the work will cost but a trifle, not more than so many dollars and cents, which gives the customer at once to understand that he is expected to pay for it, and the customer who bargains is lost.

The office under the direction of the secretary or general manager and their subordinates, makes all contracts, orders all supplies and receives all complaints; in fact, is the only communication of the company with the outside world.

The station under the superintendent, or chief engineer and his subordinates, does all the work, and is responsible only to the office, and has nothing to do with any one outside of the company.

The second principle is, that no work is to be done, except on a definite order, and all supplies used, all men's time, and all expenses are to be charged to this number, without any reference to what kind of job it may be on. Duplicate books are kept in the office, and in the superintendent's office at the station, in which the orders as they are determined upon are entered in regular routine, and the men working upon them do not need to know in the least who is to pay for the work, or in whose name it is being done; but all orders, requisitions, bills, etc., are charged to order No. "X." Any man doing work for which he has not a written authority, and a proper number to charge the same to, is not paid for the work, and then men will very soon learn that this system will save an immense amount of time and trouble to themselves.

The third principle is, that all supplies must be received and issued by the store-room; whether it be a new engine or dynamo, or a sheet of crocus cloth, the store-room must have the proper orders and receipts for such issue.

These principles being established, and the station ready to start, let us see what the first operation would be. A new order book being opened, order No. 1, made out in the office of the company, would read: "Operate Boiler Room." No. 2, "Operate Engine Room." No. 3, "Operate Arc Apparatus." No. 4, "Operate Incandescent Apparatus." No. 5, "Operate Power Plant."

These orders would practically cover the running of the station, if it be desired to itemize as is shown above. Where it is not desired to separate the cost of each of the plant, the whole might be classed under one order—"Operate the Station."

A contract, say No. 7, being made with a customer by the office, and the exact amount of work to be done by the company entered upon the form of the contract, the customer's signature is attached. A copy of the contract, detailing the amount of work and supplies to be furnished, is attached to a blank form, which is sent to the superintendent, and which is headed, "General Order No. 101," and might read, "Wire up John Jones' store for 60 incandescent lamps, as per terms of contract No. 7, hereto attached."

When arranging to make this contract, the office may have found that they have no pole line extending up the street on which this customer's store is located, and they will, therefore, have to make arrangements to build this pole line and run the wire up to reach him, at the same time they may find they have reached their limit of load on the various machines in the station. As the building of this line would probably give them a number of other customers upon it, they decide that they will at once proceed with the placing of a new 150 horse-power engine and dynamos for it, and they accordingly proceed to order the new engine and dynamo and make out two more orders, which might read: "General Order No. 102.—Build pole line and string arc and incandescent circuit on 21st street, corner of High," and "Order No. 103.—Set up new 150 horse-power engine in engine room, and connect it with the main steam pipe."

The other orders for setting up the dynamos and connecting to switchboard would follow in a like manner.

These forms signed by the secretary and general manager are the superintendent's authority for proceeding with the work, and he proceeds to fill out other forms which he delivers to the proper foreman. In this case these forms would read:

Superintendent's Office,

To Mr. Blank, Foreman Incandescent Wiremen:

Do the following work: Wire up Mr. John Jones' store, etc., as per slip attached hereto. All labor, material used, to be entered up on this form.

General Order No. 101.

This is placed upon the proper hook for the incandescent foreman, and constitutes his authority for all labor and supplies. The superintendent would then make out another order on the foreman of linemen, as follows:

Mr. Blank, Head Lineman:

Do the following work: Extend pole line, and run arc and incandescent wires up 21st street to corner of High. All materials and labor to be entered up on this form.

General Order No. 102.

Also a third order to the chief engineer:

Mr. Blank, Chief Engineer:

Set up new 150 horse-power engine in engine room, and make proper connections to steam line.

General Order No. 103.

If it is desired that this last work should be done by contract, the superintendent, it will be observed, can make this order instead of to his own chief engineer, to any contractor whom he may desire to employ; but he would make his order read: "Set up new 150 horse-power engine, etc., as per contract hereto attached," and would then have a regular contract drawn and attached to this form, which would still keep Order No. 103 as the one to which all expenses, etc., are to be charged.

Following out these three representative orders, we would say that each foreman carries a small "Foreman's Order Book," with the leaves divided into two parts. Any order written on the first half of one of these leaves, for materials, will be honored at the store-room by whoever presents it, as long as it carries the foreman's signature, and the foreman, for his own protection, writes a duplicate order on the stub, which he keeps. These orders form the store-keeper's voucher for all material issued, and the foreman who issued the order, becomes responsible for the material as soon as it has passed the counter of the store-room.

It is found very convenient to have this "Foreman's Order Book" printed on different colored paper, for the different departments.

The fireman, engineers, dynamo tenders, trimmers, etc., in fact, all who are employed on the regular routine work of the station, each receive a number of numbers from the foreman of their department, to which they charge their time from day to day, according to the hours spent on each separate item.

The book-keeper in the office, as soon as an order is entered in the order book, and the proper orders sent to the superintendent to have it carried out, opens an account on his ledger, with this order number, to which account are charged all material, supplies, etc., to be used, whether the company is to receive any money for the services or not.

When the foreman in charge of the work reports the order completed, the superintendent returns to the office the original order which he issued to the foreman, which has entered upon it all material, labor, etc., used, after taking a press copy in a letter book, which he retains as his record of the cost. The ledger account is then closed up, and the company knows precisely what this work has cost them. If they are to be paid for, it forms a basis for their bill; if they are not to be paid for, it lets them know how much money they have sunk in their construction account for this particular item.

This system of numbering orders does not extend to the accounts of the company, as entered in the ledger, except that in entering up accounts in the ledger it may be convenient sometimes to use order numbers for entering up items in an account; such, for instance, as if the company should have an account with John Jones as a customer, in John Jones' account it would be only necessary to say, "construction as per general order number so and so," and the items of the bill can then be taken directly from the order, which had originally been given to the superintendent, and which he would have returned to the office, with items of material and labor entered upon it.

While electric light companies should undoubtedly endeavor always to get rid of construction work, and simply sell current of a certain voltage at the customer's premises up to date, and for some time to come, they will probably have to do a large amount of inside work. In such cases the superintendent's order returned, with the material and labor items as above stated, can be filed directly with the contract, and in case of any question being raised by the customer, as to what material belongs to him, or to the company, a simple reference to the file will give this information.

All work of whatever kind done should be charged to some account in the ledger, and a convenient division of accounts to which items should be charged, will be found as follows:

Construction.—All poles, wire, insulators, cross-arms, and other material used in the construction of lines, whether overhead or underground. All fixtures, cranes, sockets, or wiring for incandescent lamps; and in general everything attached to a customer's premises, including any tools used for this work.

Machinery and Fixtures.—All dynamos, and parts of same; belting, station instruments and switches; and all other movable apparatus in the station.

Motors.—Where the company own such.

Office Fixtures and Furniture.—Including all furniture in and about the station.

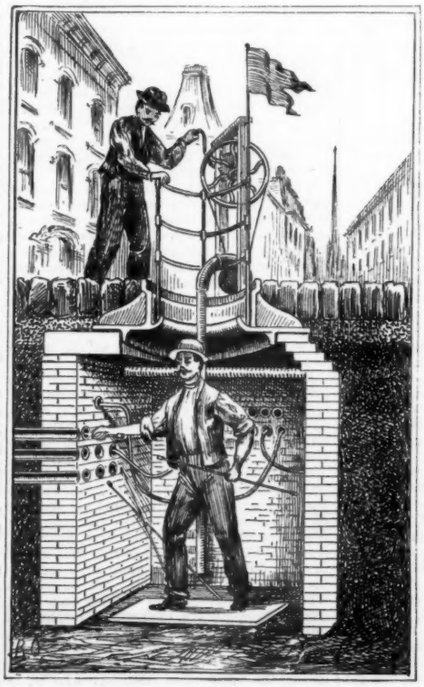
Station.—All real estate, buildings, engines, boilers, foundations, pumps, piping, shafting, and any fixed scales or machinery.

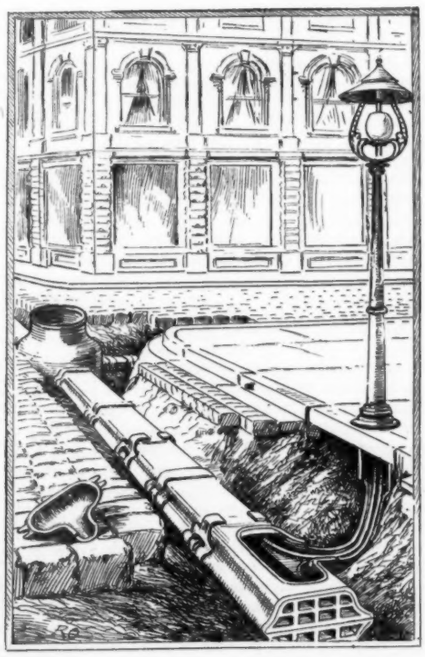
Patent and Legal Expenses.—Of every nature and kind.

Store-Room.—All material and supplies, of whatever kind, to be charged to the several departments as issued.

These various items should be, of course, considered as unavailable assets.

In what are known generally as the "expense accounts," a convenient division will be found as follows:





Advertising.
Carbons.
Fuel.
Insurance.
Interest and Discount (if any).
Interest on Bonds or Mortgages.

Lighting Supplies.—Including incandescent lamps for renewals, shades, globes for arc lamps and dynamos brushed, and other material of this nature.

Machinery Repairs.—All repairs to dynamos, armatures, station instruments or switches, arc lamps or parts of same.

Maintenance Repairs.—Being repairs to poles, lines, etc., converters in service, meters and other appliances used or located outside the station.

Shop and Station Repairs.—Repairs to

(Continued on page 16.)

KINDRED INTERESTS

Wm. Macfarlane & Co., manufacturers of thrown silks have become obliged, owing to a gratifying increase in their already thriving business, to remove their offices and salesroom from the old quarters at 55 Mercer street, to newer and larger apartments at 81 Grand street. Their mill at Bergen Point, N. J., turns out a large share of the braiding silks used in covering flexible cords and wires for electrical purposes.

The Thackara Manufacturing Company, of Philadelphia, moved into its magnificent new building, 1524 and 1526 Chestnut street, which has attracted so much attention during the process of erection, and which is, without doubt, the handsomest establishment of its kind in the country. The Thackara Company has long held a leading position among the manufacturers of gas and electric fixtures and art metal work in this country, and the increased facilities afforded by having the manufacturing departments and the salesroom under one roof, as in the new quarters, will advance it even further in this respect.

The United States Electric Safety Company are now prepared to furnish the Crandall electric protector to the public. The Chesapeake and Potomac Telephone Company are using 12,000 of these instruments, and give them a very high indorsement. Several other telephone companies are looking into the merits of this instrument with a view to adopting it in their exchanges and cable boxes. This company also furnish an instrument neatly boxed for use in houses, offices and other buildings, when necessary to have protection at both ends of the line. The Crandall protector is essentially a cut-out instrument, in this respect differing from other protectors. It consists of an electro-magnetic coil of low resistance (seven ohms) and low self-induction in series with the instrument or ground, according to the position of the armature. As far as the construction of the instrument is concerned, it has the great advantage that no spring parts are used; it depending entirely on gravity and electro-magnetic action for the motion of the armature, which is its only movable and adjustable part. These instruments are in operation at the company's office, 853 Broadway, New York.

Mr. L. M. Rheems, president, states that on December 23, the business of the Midland Electric Company, was placed in the hands of a receiver. This company has been running for the past seven years, and at first did fairly well, but getting into the hands of inexperienced and incompetent management, it gradually got deeper and deeper into debt, until last April, the stockholders, finding that affairs were far from satisfactory, made an investigation, which resulted in a complete change of administration. An assessment of 33⅓ per cent. on the capital stock was made, which helped to keep the business running temporarily, and which at the time was considered sufficient, but claims continued to come in which did not show on the books. At this time the business was placed in the hands of Mr. A. F. Blundell (for many years connected with the Nebraska Telephone Company), and since then the business has been very profitable, but the accumulation of old unpaid debts became so pressing that the stockholders became discouraged. There is scarcely a doubt but that all claims will be paid in full, as the company have a large number of outstanding contracts unfilled, and the stock on hand, if properly handled, will cover the indebtedness. Mr. Blundell, the late manager, has been appointed receiver at the instance of the Western Electric Company. The business will be carried on as long as it is for the interest of all concerned.

SYSTEM OF STATION ACCOUNTS.

(*Continued from page 15.*)

buildings, boilers and engines; piping, or any fixed machinery.

Printing and Stationery.—Of every kind and nature.

Salaries.—To the officers of the company.

Wages.—Of the employés to be divided proportionateiy to each department, as explained above by the system of order numbers.

Oil and Waste.—Of every kind.

Taxes.—Of every kind.

Of course many of these items can be put together under one head if desired. The extent to which the various accounts are to be itemized is a question for the decision of the company, but it must be remembered that in work of this kind, the more that is done in the way of saving labor, by having the books and forms printed, the less there will be left to fill in by the employés, and the more chance there will be of their doing so correctly.

Especially should this be taken care of in arranging the forms for line foremen, since it is often very inconvenient for these men to fill out their forms when out in wet or dirty weather. A convenient arrangement for this purpose is to give the man a leather case, which will just hold one of the superintendent's orders, when doubled through the center, and an indelible pencil with which to sign their orders on the storekeeper.

The only other account which is kept separately is the store-keeper's account. He should have what is practically a ledger, in which he enters up, on one side of the page all material received, to the debit of the store-room, and on the other side all material issued, to the credit of the store-room. He can thus have a page to each item of supplies, and, having a column for the amount in stock, deducts, as he issues each order, the amount of the order. He can tell at a glance how low his stock is running, which enables him to issue a requisition on the office and have the material ordered in time to prevent running out, and insert returned items.

In order to prevent the necessity of foremen sending in three or four orders for small lots of material, it is better to have a system of returning material credits, so that a foreman who requires 500 or 600 feet of wire can give his man an order on the store for a reel, the weight of which is taken when it leaves the store-room. The work being completed, the balance of the wire can be returned to the store-room, and the store-keeper makes an entry on the stub of the order remaining in the foreman's order book, crediting him with so much material returned, and makes, of course, a corresponding entry on his report of the office.

In the same way, any material which is taken down, and returned on the conclusion of a contract, is returned to the store-room, and a credit is given for it.

If the material is simply to be counted as scrap, it is sold, or set aside for sale, and entered up in the store-room book in that way; but should the material be fit for other use, such as cranes for arc lamps, etc., they can be simply entered up as returned tools.

An excellent plan is to have a record book for all material, etc., in the station, the engines being distinguished by numbers; the dynamos ditto, and all converters. The location of the engine is entered in the book, and the duty which it is doing, and any repairs made to it are charged up against it in this book. This may not seem of much importance, but in the case of converters, arc lamps, meters and such materials, it will be extremely valuable in keeping track of them.

Cases have occurred where converters have been removed from buildings when repairs have been made, and have been lost sight of for months, but a book of this kind enables them to be traced, since every change of location or repairs is entered in the book, consequently it is easy to follow them through their wanderings. Not only this, but it occasionally happens that one gets a lamp or something of that kind, which is absolutely bad, that is, it seems to be perpetually needing repairs, and it may be that in such case it will be a good deal cheaper to simply consign it to the scrap heap and get rid of it entirely. In such cases the one which takes its place can be known by the same number, and it will make no difference in the correctness of the record, since the fact that this is a new lamp will be found recorded on the page of the book devoted to that particular number.

In order to enable accounts to be kept correctly in the ledger, there must be, of course, some regular division of duties which the men themselves should thoroughly understand, in order that in charging up their time they may be able to charge the proper number of hours to the proper accounts. In a large station, moreover, there must be, and will be always, a certain amount of jealousy between the different gangs of men, and there is very apt to be some clashing, owing to fancied encroachments of one gang on duties properly belonging to another. Arising, as this generally does, from an entirely mistaken notion, it is all the harder to combat, and the best way is to prevent it arising at all if possible.

The division of duties, somewhat as follows, may be found of some assistance to this end: The superintendent is in full charge of the station, and all work done by the company of any kind or description. If the station is large enough for the superintendent to require assistance in his duties, he should have a man who can attend generally to the making out of his order, examining reports, etc., so as to take as much of the routine work as possible off his hands. In this way, during the superintendent's absence, his assistant (who needs be little more than a clerk) immediately takes his place, and while he may not be able to decide just how any particular piece of work should be done, he can often decide whether it shall be done at all or not, or whether it shall wait for the superintendent's return.

Under the superintendent comes the chief engineer, chief dynamo man, chief lineman and chief incandescent wireman.

Under the chief dynamo man come the various dynamo runners, although the chief engineer may also be able to take charge of the dynamo room, in which case it would be made a department, so to speak, of the engine staff.

Under the chief engineer come all the engineers, foremen, coal handlers, etc.

In the absence of the chief engineer, the engineer on watch takes his place, and the same with regard to the dynamo man.

The chief lineman should have under his care all pole lines and outside construction of all kinds, including all arc lamps and all high tension wires of any description; also the care of converters to the first cut-out on the secondary side. He should also have charge of the carbon setters and arc patrolmen.

The chief wireman should have charge of all inside wires in buildings, where such are under the control of the company, the care of all lamp renewals, incandescent patrolmen, and generally of all material and work from the first cut-out on the secondary side of the converters.

The store-keeper, of course, has his own duties separate from all of these.

The only reports necessary to be made will be found to be the engineer's log, for which there should be two books provided, one for the day run and one for the night run, to be filled up by the engineer on watch and turned in to the superintendent's office every morning for examination. In this should be entered the amount of coal burned, at what time each engine was started and stopped, and the other usual items, the name of the engineer on duty, etc.

It will be found much cheaper to keep constantly on hand a few lamps known to be in good condition, and, wherever an arc lamp does not work correctly, to take it out at once and bring it to the station for repairs, rather than let the inspectors attempt to fix it in place.

The store-keeper should make a report daily of all material received and issued, which report can be used by the office as a check upon bills received for material; since the bills will be laid away the store-keeper's report shows that the material ordered has been received and in what condition, and if any expenses have been incurred which should be charged against the bill. The use of forms for all these various purposes will make the actual book-keeping of the station very simple.

If the company is fortunate enough to be in a position to simply sell current and nothing else, their cost accounts will really be the bulk of their work. Should they, however, have to sell arc lights, the matter then becomes a trifle more complicated. The customer's account and bill will always be made up from his contract; renewals of lamps being charged up against his account as he receives them, unless the company furnishes renewals, in which case, however, it is well to keep a record of renewals made, in order to put a check upon any excessive breakage. In some cases, the customers who receive renewals for nothing have been caught supplying a customer who had to pay for them at half rates; or boys will bring in broken lamps for renewals from customers who are not entitled to them, giving the name of a customer who is, in order to get them for nothing. A convenient check upon this latter scheme is to have a small stamp to mark the butts of lamps where it is possible, or to have some secret mark upon the lamps to find whether they are issued from the company's office or not. This little device in one station has resulted in finding two or three people who made a regular practice of this kind of business, which, of course, was all dead loss to the company.

If a sufficient number of members of the association think well enough of this method of keeping accounts to agree to use it, if it shall be put in workable shape for them, I shall be pleased to get up such a system of forms and furnish them to them. In many cases it is the amount of detail required to think out and work up such forms that prevents their being adopted, where if they could be obtained for use they would be gladly used.

ELECTRICAL PATENTS

INDEX OF INVENTIONS FOR WHICH LETTERS PATENTS OF THE UNITED STATES WERE ISSUED ON FEBRUARY 18, 1889.

421,396 Cut-out; Gustav A. Frei, Boston, Mass., assignor to the Bernstein Electric Light Manufacturing Company, Portland, Me.

421,398 Conduit for electric railways; Patrick H. Griffin, Buffalo, N. Y.

421,464 Electric railway car; Herbert C. Wert, Boston, Mass.

421,469 Arc light carbon; Walter E. Adeney and Llewellyn Saunderson, Kingstown, County of Dublin, Ireland.

421,479 Dynamo electric machine; DeWitt B. Brace, Lincoln, Neb.

421,484 Camera and electric flash attachment; Geo. E. Davis, Dubuque, Ia.

421,498 421,499 Apparatus for heating water and generating steam by electricity; John C. Hubinger, Keokuk, Ia.

421,508 Electrical annunciator; Albert F. Parks, Troy, assignor to Chas. E. Lee, Rochester, N. Y.

421,535 Switch for systems of electric locomotion; Frank Wheeler, Meriden, Conn.

421,567 Electric clock; William Grah, Jr., Toledo, Ohio.

421,586 Incandescent lamp socket; William P. Kookogey, Brooklyn, assignor to the Kookogey Electric Company, New York, N. Y.

421,630 Electric lamp adapter; James Stewart, New York, N. Y., assignor of one-half to Edmund C. Stanton, same place.

421,636 Telephone switch; Erastus C. Titus, Catskill, N. Y., assignor of one-half to Harry M. C. Vedder, same place.

421,666 Electrode for secondary batteries; Hiram H. Carpenter, New York, N. Y.

421,733 Carbon for arc lamps; Edward L. Liedke, Sandusky, Ohio, assignor of one-half to Frank K. McGormick, same place.

421,781 Electric conductor; John A. Stoughton, East Hartford, Conn.

421,790 Electric motor; Philip B. Walsh, Philadelphia, Pa., assignor to Charles M. Rhodes, same place.

421,791 Electric railway signal; Willie C. Walter, Richmond, Va., assignor of one-half to George B. McAdams, same place.

421,801 Electric battery; Chas. Willins and Gustav A. Liebig, Jr., Baltimore, Md., assignors to John A. Barett Battery Company, same place.

421,802 Flexible electric connection; John F. Wollensak, Chicago, Ill.

421,819 Insulator; John W. Davy, Pittsburgh, Pa.

421,851 Electrical indicator; Geo. Bock, Jr., New York, N. Y., assignor of one-half to Chas. L. Wright, same place.

421,853 Automatic fire alarm system. 421,854 Automatic fire alarm transmitter; Geo. F. Bulen, Tompkinsville, N. Y.

421,864 Hanging device for electric lamps; William H. Layng, New York, N. Y., assignor to S. Samuel Miller, Paul J. Chassange and William R. Palmer, Akron, Ohio.

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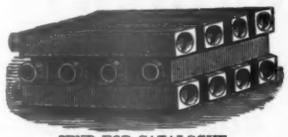
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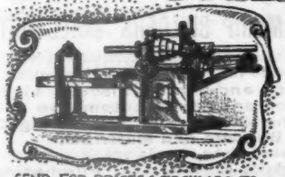
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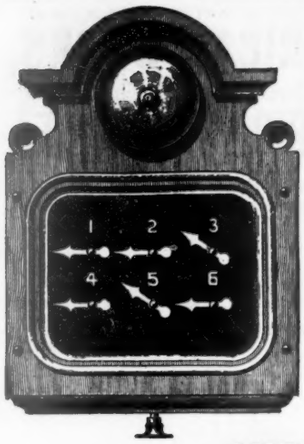

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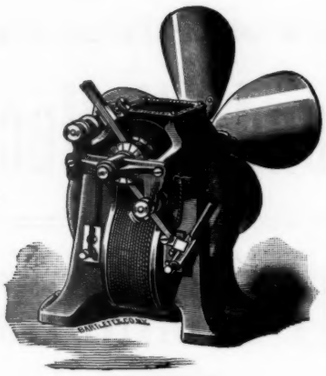

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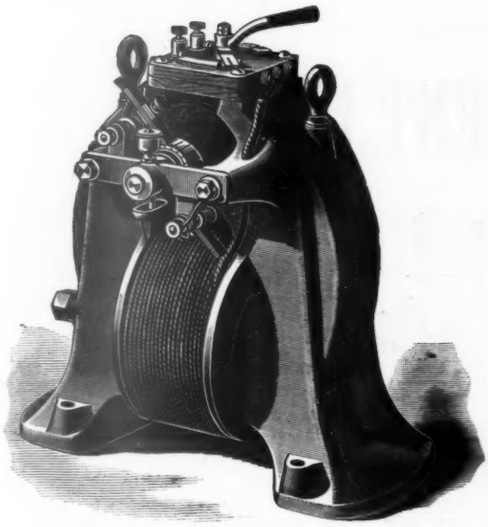

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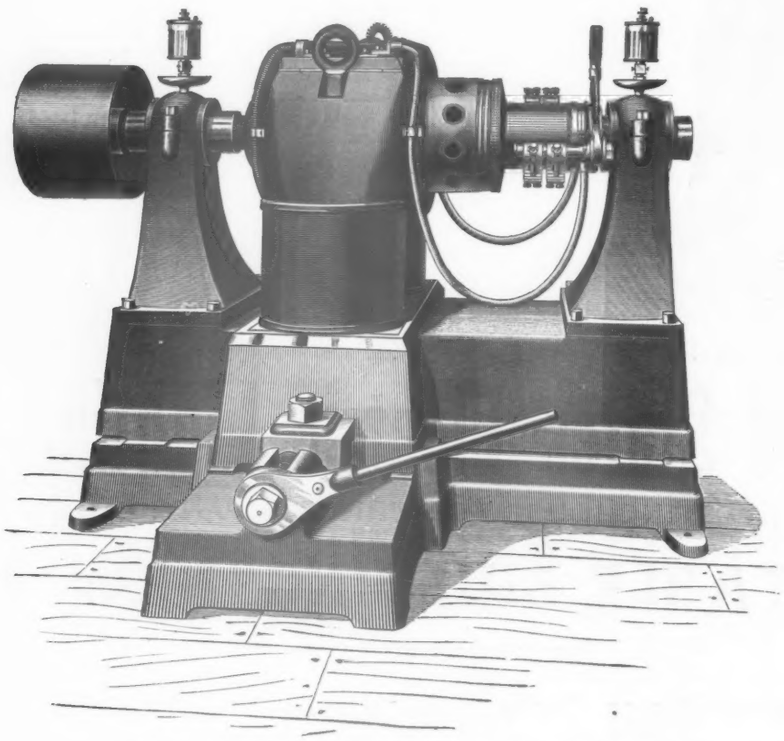

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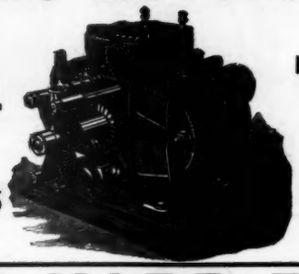

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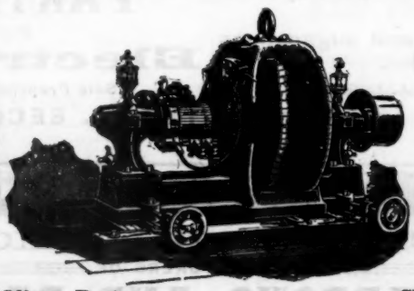

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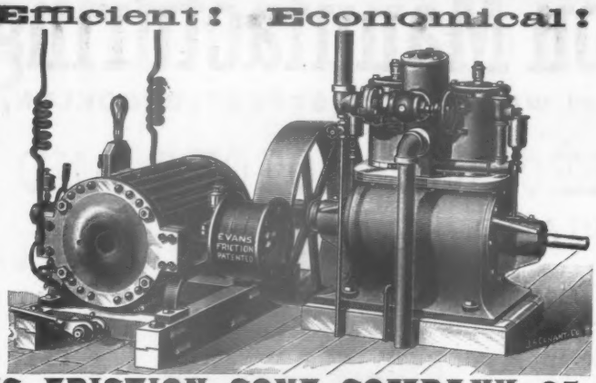

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Designation of Machine.	No. Lights 2,000 c. p. 10 amp. X	No. Lights 1,200 c. p. 6 amp. Y	No. Lights 1,200 c. p. 4 amp. Z	No. Lights 800 c. p. 4 amp.	Horse-Power at Pulley of Dynamo.	Width of Single Belt in inches.	Belt Speed Required.	Weight of Dynamo.
C	8	.....	.....	.....	6.5	1¼	5,000 FEET PER MINUTE.	530
C	.....	10	.....	.....	6.3	1¼		530
C	.....	.....	.....	25	8.0	2		530
E	16	.....	.....	.....	12.0	2½		780
E	.....	20	.....	.....	12.5	2½		780
E	.....	.....	26	.....	13.0	2½		780
E	30	.....	.....	.....	15.0	3		990
E	.....	25	.....	.....	15.6	3		990
E	.....	.....	32	.....	15.0	3		990
E	.....	.....	.....	50	16.0	3		990
C	28	.....	.....	.....	21.0	4½		1,360

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LIST OF DYNAMOS IN STOCK.

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G	.....	35	.....	.....	21.0	4	5,000 FEET PER MINUTE.	1,360
G	.....	.....	45	.....	21.0	4		1,360
G	.....	.....	.....	70	21.0	4½		1,360
H	40	.....	.....	.....	29.7	6		1,750
H	.....	50	.....	.....	30.0	6		1,750
I	.....	.....	64	.....	29.5	6		1,750
I	52	.....	.....	.....	38.0	8		2,290
I	.....	65	.....	.....	38.6	8		2,290
J	.....	.....	88	.....	38.0	8		2,290
J	64	.....	.....	.....	46.5	10		2,770
K	.....	80	.....	.....	47.1	10		2,770
K	75	.....	.....	.....	52.5	12		3,300

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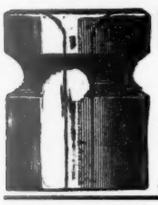

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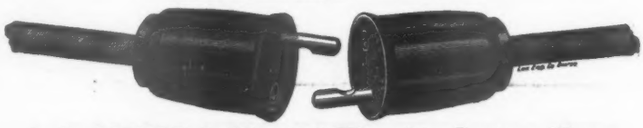

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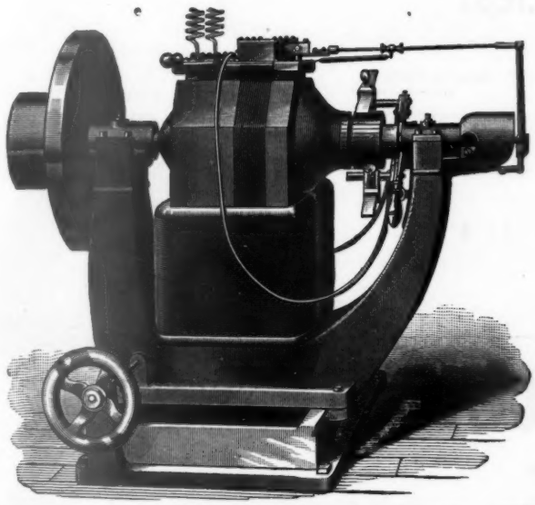

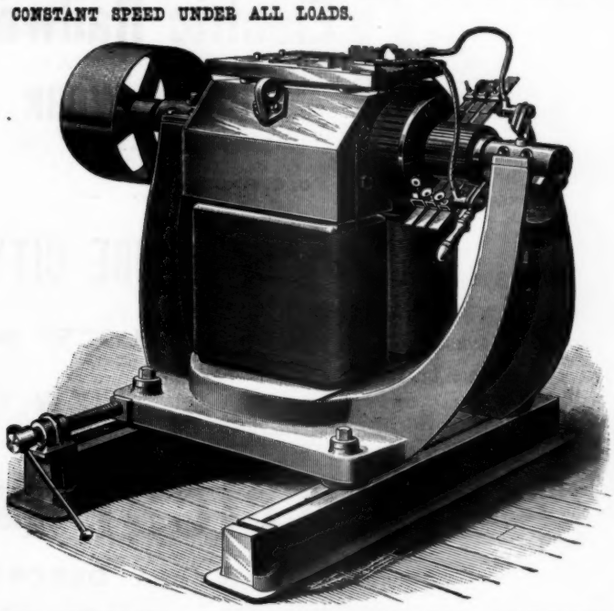

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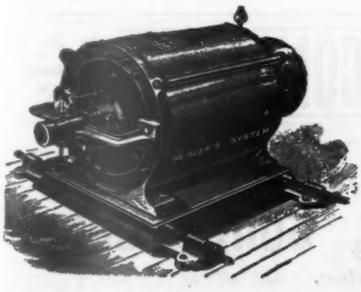

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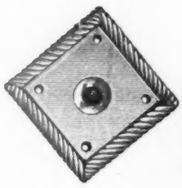

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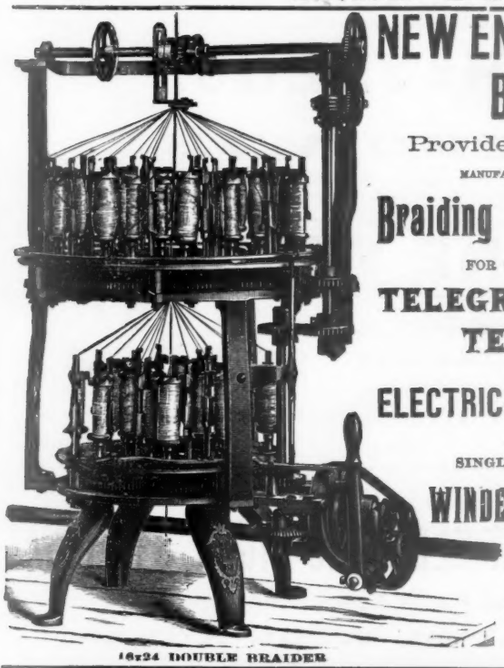

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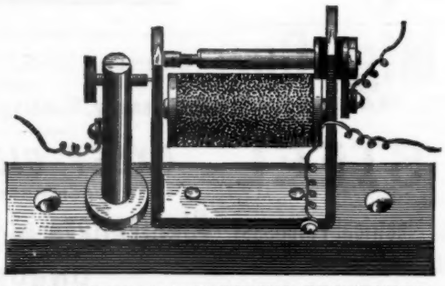

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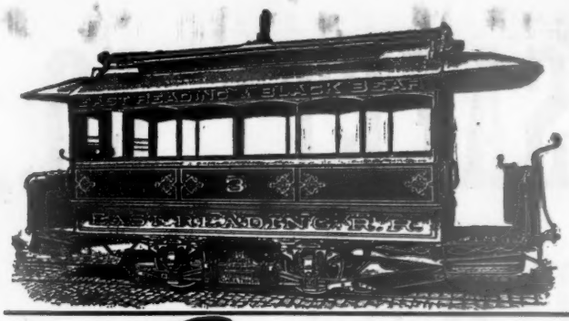

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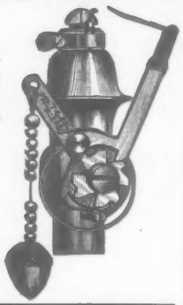

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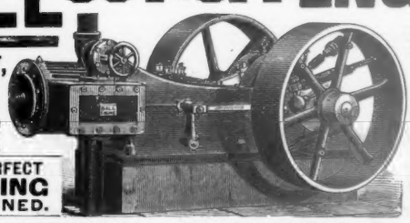

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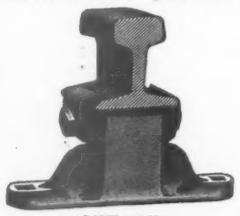

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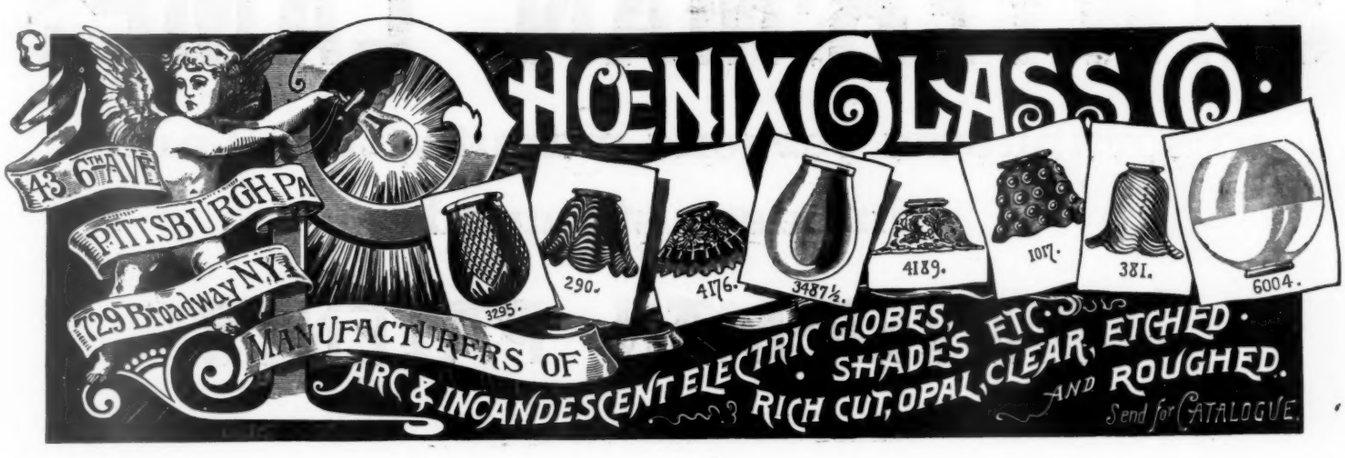

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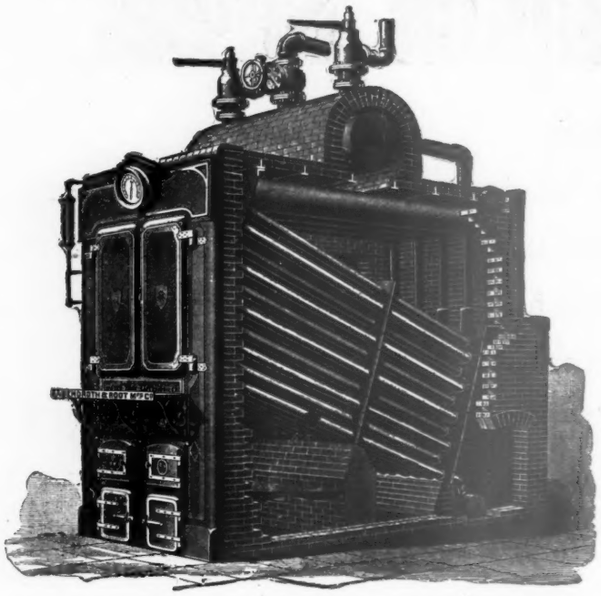

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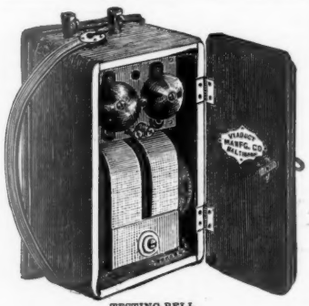

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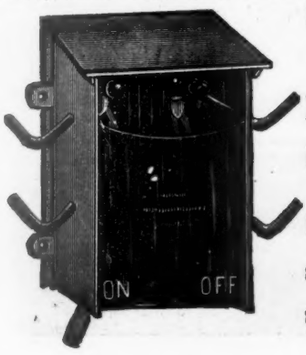

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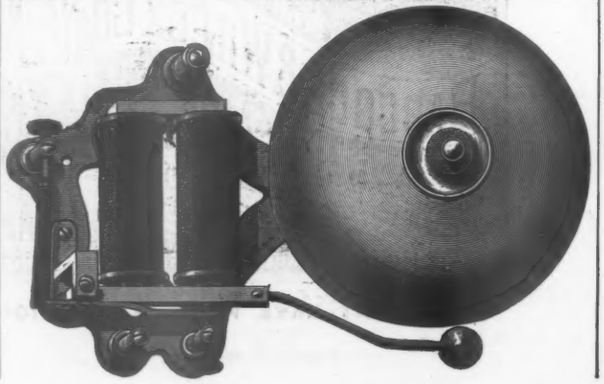

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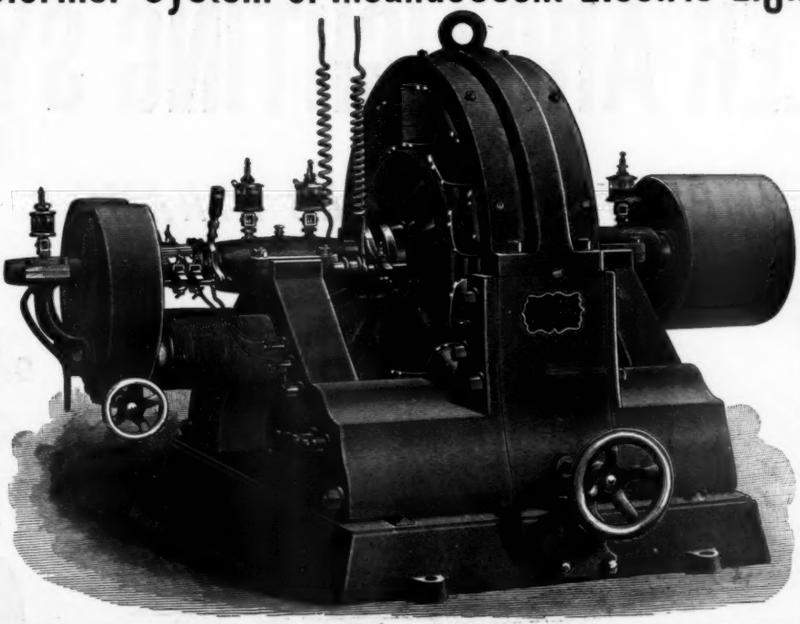

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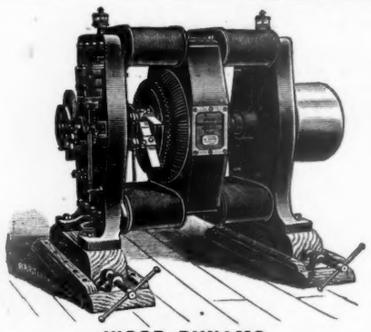

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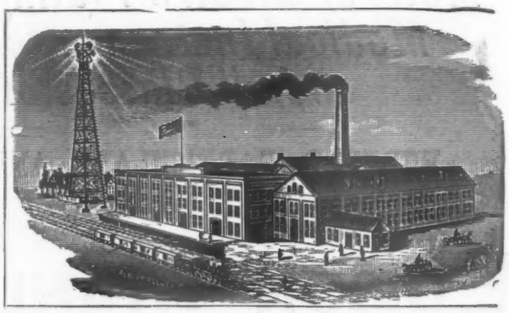

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